THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXVI.—No. 25 Whole No. 1,150. | NEW YORK, MONDAY, JUNE 21, 1897. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

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The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

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[OFFICIAL NOTICE.]

Fifth Annual Meeting, Pacific Coast Gas Association.

PACIFIC COAST GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
OAKLAND, CAL., June 4th, 1897.

The fifth annual meeting of the Pacific Coast Gas Association will be held at San Francisco, Tuesday and Wednesday, July 20th and 21st, 1897, at 10 o'clock, A.M., in the office building of the San Francisco Gas and Electric Company.

A meeting of the Board of Directors will be held on Monday, July 19th, at 8 P.M., at headquarters in same building.

The following papers will be read and discussed during the sessions:

The President's Address, by Mr. T. R. Parker, Napa, Cal.

"Spontaneous Ignition of Coal," by Mr. John L. Howard, San Francisco.

"Reminiscences," by Mr. F. H. Eichbaum, San Francisco.

"Value of Small Gas Bills," by Mr. W. W. Gillespie, San Francisco.

"From Coal Gas to Natural Gas," by Mr. John Kempf, Jr., Salt Lake City, Utah.

"Small Lighting Plants and their Management," by Mr. Thos. D. Petch, Eureka, Cal.

"Practical Suggestions," by Mr. Chas. E. Burrows, Walla Walla, Wash.

"Uniformity of Accounts," by Mr. C. O. G. Miller, San Francisco.

"Municipal Control," by Mr. C. W. Quilty, San Jose.

"A Short History of a Long Life," by Mr. C. M. Converse, San Francisco.

"Recuperative Benches for Coke and Coal Firing," by Mr. D. R. Russell, St. Louis, Mo.

"Card Bookkeeping," by Mr. V. Stow, San Francisco.

"Gas as Fuel," by Mr. F. Foveaux, San Francisco.

Questions received will be assigned to members for reply.

The "Experience" Department, edited by Mr. John Clement, of Red Bluff, Cal., and the "Wrinkle" Department, edited by Mr. M. C. Osborn, of San Diego, Cal., will make report.

All gas men sojourning in San Francisco at the time of the meeting are cordially invited to be present and to participate in discussions. The Secretary will at all times cheerfully answer any questions and furnish information concerning the meeting, hotel accommodations, etc.

Thursday, July 22d, 1897, will be the outing day for members, their families and friends. A trip on the world-famed scenic railway to the top of Mount Tamalpais will be made, and luncheon served at the "Tavern of Tamalpais." From San Francisco to the mountain top there is revealed the grandest panorama of ocean, cities, towns, bays, valleys and mountains in the world, the view reaching from the snow-capped Sierras to 60 miles from the Marin county shores on the Pacific. The usual banquet will be held on Tuesday evening, July 20th.

Eastern members, and others from the Eastern States intending to visit San Francisco, are requested to advise the Secretary in advance.

JOHN A. BRITTON, Secretary.

[Official Notice.]

Appointment of Special Committees, American Gas Light Association.

American Gas Light Association,
Secretary's Office, Montclair, N. J., June 14, 1897.

The following gentlemen have been named by the Council of the American Gas Light Association, to serve on the specified committees:

Nominating Committee.—M. S. Greenough (Chairman), Cleveland, O.; T. Littlehales, Syracuse, N. Y.; C. W. Blodget, Brooklyn, N. Y.; James Somerville, Indianapolis, Ind.; A. K. Quinn, Newport, R. I.

Committee of Arrangements.—Capt. William Henry White (Chairman), New York City; A. C. Humphreys, New York City; H. L. Rice, Norfolk, Va.; C. H. Dickey, Baltimore, Md.; Alten S. Miller, Long Island City, N. Y.; William E. Helme, Philadelphia, Pa; Charles H. Nettleton, Derby, Conn.; Alfred E. Forstall, Montclair, N. J.

Finance Committee.—G. G. Ramsdell (Chairman), Philadelphia, Pa.; W. R. Beal, New York City; Geo. Treadway Thompson, New York City.

Alfred E. Forstall, Secretary.

BRIEFLY TOLD.

The Fifth Annual Meeting of the Pacific Coast Gas Association.—The official announcement by Secretary Britton, of the Pacific Coast Gas Association, respecting that which the members may count on for their technical entertainment at the meeting, to be held in San Francisco next month, leaves nothing to be desired. The paper list shows no less than 12 set numbers, on subjects full of interest, and the Association is to be congratulated over the fact that its members are mainly of the active degree; that is, men willing to perform positive work along the lines on which the Association is based. The 12 set papers, too, are flanked by other matters of technical interest; for President Parker can certainly be counted on, in his inaugural address, to put forth much that will be well worth dissecting and applying. Then, the Experience Department, under Mr. Clement's careful handling, and the Wrinkle Department, by virtue of Mr. Osborn's competent editing, are bound to be fruitful in worth. Again, Secretary Britton is spurring on other individual members to times of thoughtfulness, through the assigning to them of questions which they are supposed to either be prepared for answering in person when the proper time comes, or, failing their personal attendance at the meeting, to have their written replies in his hands for reading at the sessions. The outing programme for the third day means a royal round of pleasure that cannot fail to be thoroughly appreciated by those who shall have the good fortune to participate in it.

Notes.—The Kerr Murray Manufacturing Company has been awarded the contract for the construction of a double lift holder, to rest in steel tank, by the proprietors of the Omaha (Neb.) Gas Company. The capacity of the vessel is put at 400,000 cubic feet.——At a meeting of the shareholders of the Paterson (N. J.) Gas Light Company, held at the Company's office on the 16th inst., the following Directors were elected, to serve during the ensuing year: John Reynolds, W. L. Williams, James Dunn, John S. Cooke, W. H. Williams, John H. Reynolds and A. S. Allen. The Directors subsequently perfected the following executive organization: President and Treasurer, John Reynolds; Vice-President, W. L. Williams; Secretary, R. Schoenmaker.——Mr. W. A. P. McDonald, President of the St. Joseph (Mo.) Gas Company, announces that a meeting of the shareholders will be held on August 4th, for the purpose of determining whether or not an issue of bonds, "amounting in the aggregate to not exceeding 1 million dollars," shall be issued on the properties of the amalgamated gas interests of St. Joseph.——A plant for the manufacture of calcium carbide on a fairly large scale is to be constructed at Pedlars, a place on the James river, about 15 miles west of Lynchburg, Va. We understand that the promoters have secured there the right to a water power, aggregating 2,000-horse, which power can be depended upon the year through.——The proprietors of the Atlanta (Ga.) Gas Light Company have recorded a mortgage for $1,150,000. Of this amount $1,000,000 goes to retire a like amount of an existing issue, the balance of the issue being used to pay for improvements on the works.——Mrs. Gesine Lemcke has just completed a series of demonstration lessons on cooking by gas, at the instance of the South Amboy (N. J.) Gas Light Company. The lectures (which were given on each afternoon and evening of the week ended June 12th) were largely attended.

[Prepared for the Journal.]

Pipes and Piping: Patterns, Materials and Methods Best Suited for Plant and Line Construction and Maintenance.—No. II.

By Mr. C. P. Russell.

From the holder outlet the only remaining piece of apparatus located in the plant is the street pressure governor. This instrument, of course, is one without which no works is fully equipped, and upon its selection and proper adjustment much of the financial success of a gas undertaking is dependent. Many types of this apparatus are to be chosen from; the satisfactory operation of any of them is governed largely by the manner in which it is set. Whatever type is determined upon should be, as in the case of every other apparatus in the plant system, set with inlet, outlet and bye-pass connections and valves. The leveling of the instrument is a very delicate piece of work, and should be done with the utmost care and precision. Faced, flanged joints are the most desirable, in fact, are the only ones that can be relied upon to secure the maintenance of the apparatus in its proper position. Accessibility is a feature that must not be overlooked. There are certain times at which no street pressure governor can be relied upon to take care of the requirements. Extraordinary conditions sometimes prevail that are necessarily without the province of the governor. This apparatus is designed to meet the demands that, in experience, have proved to be most general. Abnormal demands occasionally arise where the use of the governor must be dispensed with to insure a perfect supply to the main distributing system. The principle of the governor being retroactive makes certain limits of adjustment imperative; and hence it is that when demands not within the prescribed limits have to be met, the use of the bye-pass valve must be resorted to.

At the outlet of the governor begins the main system proper, and, this being the link that connects the producer and the consumer, its plotting, installation and development are matters requiring thorough consideration and careful study. Despite the numerous very elaborate literary contributions that have appeared on this subject, and the valuable tables and formulae that we have at our command, by which, theoretically, a perfect distributing system can be worked out, the fact remains that but few companies have in any way nearly approached perfection, and those that have reached this point have done so through methods that were suggested by actual condition, and not on principles dictated by theoretical possibilities. The writer does not wish to be thought guilty of decrying the merits of calculative basis, neither does he claim that the formulae and tables are not all right; he has had occasion to prove their correctness and to profit by their value too often to take such an untenable position, but he does assert, and that, too, advisedly, that if the rules and tables are followed literally, and the operations carried out in line with their conclusions, the result will be far removed from that which the trusting disciple of the savants, no doubt, confidently expected.

It is not the purpose of this article to dwell upon the construction of pipe lines from a mathematical standpoint, nor to treat exhaustively upon methods affecting the coursing, paralleling and contouring of the work, and the compiling and preservation of the data relating thereto. The desirability of these details is conceded, and the suggestions already before us in this connection are so complete and so well worthy of acceptance, as to preclude the probability of anything original being offered. Suggestions, though, of a practical nature in so far as the mechanical operations, the selection of appliances and adoption of materials are concerned, are so conspicuous by their absence that the writer believed he could better serve his co-laborers in attempting to supply this deficiency than by "re-hashing" that which is now ancient history.

The distributing system may be classified under two headings, mains and service pipes. Under the former caption are included the pipes used for conveying the gas, and the various branches, fittings, valves and drip pots used in the line construction. Under service pipes the lines connecting the street main with the consumer's fittings, as also those used for supplying the burners of the public lamps, will be referred to.

Of the materials suitable for main pipes, those most in common use are cast iron, wrought iron, steel, and the latest applicant for public favor, the so-called fiber pipe. With the three first mentioned we are all more or less familiar, and once having decided upon which shall be used nothing remains to be done except to effect its purchase and proceed with laying it. With the fiber pipe no one can as yet lay claim to having had a sufficiently extended experience to justify recommending its adoption or rejection. Although the article has been upon the

market for some time, it cannot be said that its utility, or other points of superiority claimed, have had time for corroboration, and hence we cannot regard it in any other light than that of an experiment. Every one, of course, is anxious to satisfy himself of its excellence, if such exists, and with this end in view is certainly justified in conducting his own investigation. Therefore, it would be well to lay a trial section in some less important district where, from time to time, it might be examined and tested.

With the nature of iron and steel we are well acquainted, and if a bad lot of pipe of either of these materials should be allowed to enter the system, the fault cannot be attributed to ignorance. It is admitted that quite frequently price secures the contract, and that it is far too often the case that quality is sacrificed for cheapness. However, even though the purchase is made on open order, and not under specification, it is inferred that the material will be the best of its respective kind, unless the contrary is expressly stipulated. Therefore if, after careful inspection, the pipes prove to be in any way defective, they should be so marked and promptly rejected.

The varieties of cast iron are numerous, the quality being in a measure indicated by the shade or color of the fracture. The principal divisions (the properties of which are very different) are gray and white. The former is the softer and less brittle, is slightly malleable and flexible, and may be easily cut and drilled. The fracture is brilliant, of a grayish or bluish-gray color. As the grain becomes closer the color is of a lighter shade and the hardness perceptibly increases. Melting at a lower heat and retaining its fluidity longer than the white, the gray moulds much better, contracts in a lesser degree and has decidedly fewer cavities, and hence is admirably suited to pipe work on land. White iron, having qualities directly the reverse, is unfit, and upon the least indication of its largely entering the composition of the material designed to be used, the suspected piece should be thrown aside and its acceptance refused. It must be remembered, however, in employing the color test, that as the color and texture of cast iron are greatly dependent upon the body of the casting, and the rapidity with which the mass is allowed to cool, that the test must be more than superficial. A small casting, owing to the comparatively short time required for its cooling, is generally white; and it is a well known fact that the exterior or outer surface of a large or heavy casting shows more of the quality of the white metal than does the interior.

Careful attention should be paid to the varying weights of pipe of equal diameters and lengths. At a meeting of the Society of Gas Lighting, held on January 21st, 1892, a committee, to whom the question was referred, submitted a report recommending the adoption of rules and schedules relating to pipes and special castings, which was subsequently accepted by the leading pipe manufacturers. Dimensions and weights were given, and in the purchase of pipe the careful engineer will be largely guided by these figures. Deviations of 5 per cent. above or below the theoretical weights may be allowed to compensate for what appears to be an unavoidable irregularity in casting.

Long years of usage have demonstrated the value of cast iron pipe as a satisfactory conduit for gas. Under almost every condition it has proved its ability to withstand the ravages of time, when the iron was originally of good quality and the installation properly made. There have been instances where unexplainable circumstances have brought about its comparatively early destruction, but in almost every case experiments have failed to provide any other material that would answer as well, without the use of some remedial agent in the way of a protective coating. In this connection the writer, after a series of experiments, adopted the rules and conditions prescribed by the Municipal Water Department, of the city of Philadelphia, regulating the application of coal tar varnish as applied to cast iron pipes and castings supplied to that department. Having satisfied himself of the merits of the process, both as regards economy and effectiveness, he recommends its use to those who are placed in a position requiring such measures, and submits below, for their information, abstracts from the specification:

1. Every pipe must be thoroughly dressed and made clean, free from the earth or sand which clings to the iron in the moulds; hard brushes to be used in finishing the process to remove the loose dust.

2. Every pipe must be entirely free from rust when the varnish is applied. If the pipe cannot be dipped immediately after being cleansed, the surface must be oiled with linseed oil to preserve it until it is ready to be dipped; no pipe to be dipped after rust has set in.

3. The coal tar pitch is made from coal tar, distilled until the naphtha is entirely removed, and the material deodorized. It should be distilled until it has about the consistency of wax. The mixture of five or six per cent. of linseed oil is recommended. Pitch, which becomes hard and brittle when cold, will not answer for this use.

4. Pitch of the proper quality having been obtained, it must be carefully heated in a suitable vessel to a temperature of 300° F., and must be maintained at not less than this temperature during the time of dipping. The material will thicken and deteriorate after a number of pipes have been dipped; fresh pitch must, therefore, be frequently added; and occasionally the vessel must be entirely emptied of its old contents and refilled with fresh pitch. The refuse will be hard and brittle like common pitch.

5. Every pipe must attain a temperature of 300° F. before it is removed from the vessel of hot pitch. It may then be slowly removed and laid upon skids to drip.

All pipes of 20 inches diameter and upward will require to remain at least 30 minutes in the hot fluid to attain this temperature; probably more in cold weather.

The proper coating will be tough and tenacious when cold on the pipes, and not brittle: nor will there be any tendency to scale off.

Of course it is not desirable that the interior surface of the cast iron pipes intended for the conveyance of gas should have this coating. Therefore, suitable plugs must be provided to prevent the entrance of the varnish when the pipe is in the bath. Some engineers deem it advisable that the spigot end of the pipe be not coated over the exterior surface for a distance of 4 or 4½ inches, alleging that a better joint results when the iron is bare. This theory is not sustained in practice, nor can any plausible reason be advanced why it should be. Water pipes are subjected to much greater pressure than gas pipes, yet they are coated over their entire surfaces, and the manner of making the joint does not differ materially from that followed in connecting gas pipes. As there is no bond between the lead used in running the joint and the iron it is difficult to see wherein any advantage is to be derived. If cement joints are to be used, an advantage might be claimed, but that it is of great consequence is questionable. In masonry building operations, pitch is extensively used between courses to prevent dampness, and it certainly does not seem reasonable to suppose, if its use interfered with the adhesion of the cement to any extent, that the practice would be countenanced by the building departments of our largest cities.

The advocates of the use of wrought iron pipe for gas mains can offer some very strong arguments to support their claims. It has been suggested that the use of wrought iron pipe might prove very unsatisfactory because of the small section of metal offered when making a tap for a service connection. This objection can hardly be sustained if in selecting the pipe care is taken that the same pipe as is designed for water is furnished. Such pipe, as manufactured by the most prominent tube works, is admirably adapted to the requirements of gas distribution, and, with the use of the "Converse lock-joint," the objection to screwed ends that is also frequently advanced is entirely overcome. One end of each length of pipe has the lock-joint affixed thereto before leaving the factory, and the operation of joining the different lengths is as simple as in the case of cast iron pipe. Ordinarily wrought iron pipes corrode more rapidly than cast, but by subjecting them to the "kalameining" process they are rendered almost rust-proof. "Kalameining" consists in "incorporating upon and into the body of the iron a non-corrosive metal alloy, largely composed of tin." The protective surface thus formed is not subject to destruction through rough handling, nor is it cracked in bending the pipe. The points of toughness, pliability and lightness are decidedly in favor of the wrought iron. Its lightness admits of its being more easily handled; its toughness and pliability permit of a deflection in getting around obstructions that would require special fittings with cast iron. In the item of cost, wrought iron pipes are cheaper per foot notwithstanding that the price per ton is considerably more than that of cast. With the proper appliances at hand, a wrought iron pipe may be safely bent to any desired angle not exceeding 25°. The lengths of these pipes are from 18 to 20 feet. so that fewer joints per mile are required. No yarn being necessary and so much less lead per joint is needed that these items also effect an appreciable saving in the cost. The manufacturers of wrought iron pipe have unquestionably made rapid progress during the present decade in perfecting their wares and adapting them to the uses in which cast iron formerly held undisputed supremacy. Special fittings, such as crosses, tees, reducers, bends, etc., are now to be had, fitted with the lock-joint, and these, together with the method of tapping for service by employing the service clamp, have succeeded in placing wrought iron on a parity with cast iron pipes in so far as convenience and prompt delivery are concerned.

Fig. 1 shows a section of hub connecting the ends of pipes. By reference to the drawing the following description will be more readily understood. As manufactured, the "Converse lock-joint" is cast to

suit the different diameters of pipes it is intended to connect. The ends of the pipes are introduced into the hub, and strike against the stop or bead, thus accurately centering the connecting lengths and presenting a smooth and regular interior surface. The rivets enter the slotted opening or way, and the pipes, when inserted, are set up until

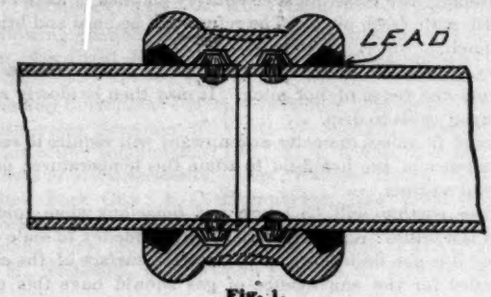

Fig. 1.

the ends engage the bead, and are then given a turn to the right, or left, as the case may be, until the rivets, which now find another opening or way introduced at right angles to that paralleling the run of pipe, lock the joint. The lead is then cast into the wedge shaped recess in the hub and the joint is complete, caulking being but seldom necessary.

Fig. 2 shows the clamp used in connecting services. Its design and advantages, as also the method of attaching it, are so evident that a description is hardly required.

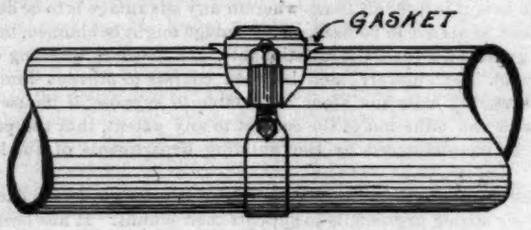

Fig. 2.

With the comparative merits of the materials before him as explained, one should find no difficulty in deciding which of them would be best suited to his individual requirements. In the writer's experience, he has, at times, found it advisable to use both wrought iron and cast iron pipes in connection, his determination being based upon local observation and the selection governed by the peculiar natures of the soils and the varying conditions as to stress, exposure, etc., to which the line would likely be subjected. It is perhaps superfluous to say that iron of uniform quality will not meet every condition with uniform success. The action of salt (or brackish water, and of salt, marshy soils, for instance) is far less destructive to hard white or light gray castings than it is to the soft, bluish gray. The latter, being higher in the percentage of carbon mechanically combined with it, corrodes quite rapidly, the iron becoming very soft and assuming a plumbaginous appearance and nature, whereas the former, being lower in the percentage of contained carbon, is chemically combined therewith and, therefore, is much less subject to destruction. Wrought iron is also quickly affected under the above conditions, and although it has been largely employed in pipe lines intended for the conveyance of gas across the bottoms of streams, its use for such purpose cannot be recommended. Unquestionably, its employment in this direction has been largely influenced by its pliability and the consequent ease with which it could be handled, but with the means we have at our command the use of cast iron pipe in such cases is rendered not only practicable but satisfactorily successful. Fig. 3 illustrates the "Ward" flexible joint

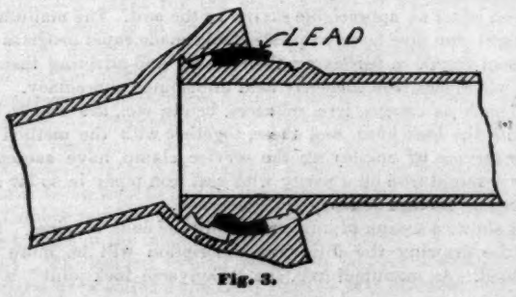

Fig. 3.

designed for use on cast iron pipe in crossing river beds, etc. A portion of the bell, from the face thereof to the stop, starting from a center formed by the intersection of a line drawn from the under side of the face of the bell to the stop opposite and a horizontal center line drawn at right angles to the face, is turned to form the middle zone of a sphere. The spigot of the connecting length of pipe has an interlocking stop on the outer surface, turned to form the segment of a circle, fitted to engage the corresponding stops in the bell. The lead is cast as in ordinary practice, but is secured around the spigot in such manner as to prevent its sliding or being displaced from its position. This construction partakes of the characteristics of the ball joint, although the deflection is limited to 15°, and will meet all conditions under which a submerged pipe line is at all practicable.

Having decided upon the quality of pipe material, a question of importance regarding the joints arises. Many discussions have taken place on this point, but the only decision as yet arrived at is that individually held by the champion of some particular self-conceived or blindly accepted theory. The lack of any unanimity of opinion, even among those who have espoused somewhat similar methods, proves conclusively that this matter has been but lightly considered, and, notwithstanding the fact that the analysis of most companies' accounts will reveal a condition of affairs in the direction of unaccounted-for gas that is truly deplorable, but little is being generally done to seek out the causes and apply an efficient remedy. The basis of calculation adopted by many is no doubt largely responsible for this. It is almost invariably the practice in estimating the unaccounted-for gas to base such estimates upon a percentage of gas accounted-for as against the total sendout. The continued increase in the use of gas, year after year, has naturally served to materially reduce these percentage figures, and the happy manager silently congratulates himself that "things are coming his way," whereas, should he investigate more closely, he would find that the *volume* unaccounted-for hasn't decreased one iota, but, on the contrary, has increased, although not in the same proportion as the sales. For example: Assume a plant to have an output of 40,000,000 cubic feet per annum, the unaccounted for gas being 4,000,000 cubic feet. This shows a percentage of 10. Now, suppose the output increases until it reaches 60,000,000 cubic feet, the amount of unaccounted-for gas remaining the same, the percentage will be reduced to 6⅔, apparently indicating a reduction in amount unaccounted-for, but actually showing no improvement whatever.

The above remarks are by way of explanation, and are intended to warn those who may unsuspectingly be induced to accept some particular method, the merits of which are supposedly brought out through some such system of figuring.

In ordinary straight line street work, where cast iron pipe is used, the bell and spigot type of joint is almost universally adopted. At street intersections, the common practice is to introduce 4-way branches or crosses, having four bells, or three bells and a spigot in the run. This practice should unquestionably be improved upon, and the attendant expense in making the junctions in the manner hereafter described is so little in excess of that incurred in the older method, as to be hardly worthy of consideration when weighed against the advantages to be derived. A cross or 4-way, with flanged ends, will recommend itself because of the convenience it offers in the way of connections and the opportunity it affords of being easily removed from the line in case of alterations, without disturbing the connecting lines. Moreover, it serves the purpose of keeping the lines diverging from its center at absolute right angles to one another, besides insuring an uninterrupted flow of gas in the various directions, by reason of the lines being necessarily true and free from those obstructions so incident to the use of bell and spigot pipe through the difficulty experienced in obtaining concentric joints. If bells are desired ahead, they may be had by the use of a separate flange and bell piece bolted to the 4-way, and although this calls for the use of an extra fitting, the expense is offset by dispensing with the use of a sleeve that would otherwise be necessary to obtain the desired end.

Address of the President, Mr. Corbett Woodall, at the General Meeting of the Incorporated Institution of Gas Engineers.

To those who, perforce, recognize that the greater part of their working life is behind them, it is natural to discover and welcome occasions for retrospect. Indulging this tendency, it occurred to me—I think naturally—when considering what to say in this address, that I should look back over the interval that has elapsed since it was last my pleasure to preside over a technical society representing the British gas

industry; and glancing briefly at the changes I have noted in the principles and practice governing the contact of gas undertakings, deduce from them, if possible, some suggestions for the future. This was, I say, natural to me; but it surprised me to find, when too late, that much the same sentiment had influenced my esteemed predecessor, Mr. Foulis—without, I think, the same justification—when he addressed you last year. I have one very quailfied advantage over him, however, in that it is not nine, but nineteen, years which have elapsed since I occupied a corresponding place to this.

Nineteen years, I am reminded in many ways, is a large slice out of the professional experience of a man, although it may not be a great span in the history of a national industry. "Art is long, life is short;" and perhaps the most that the busiest and happiest of us can hope for in a survey of his past, is that the glance may not be upward as well as backward. This is emphatically not the case with the British gas industry. I look back to the period of my presidency of the British Association of Gas Managers in 1878; and although, of course, the main lines of gas engineering practice are of the same origin and aim as they were in those days, I am impressed with the range and diversity of the later growth and development through which those lines now lie.

In the manufacture of gas, and in almost every corner, so to speak, of a modern gas works, what 19 years ago was done wholly by manual labor, is now effected, to considerably greater advantage, by mechanical means; and types of apparatus that had been sanctified by the approval of generations of designers and workers, have been replaced by quite different appliances. In order that this might be, it was necessary that an even greater and more far reaching change should be made in the substitution of more exact knowledge, of clearer reasoning from more careful experimental data, for the old "gas works routine," familiarity with which was, and to some extent still is, esteemed a complete equipment for a gas works manager. I would not be understood as speaking lightly of routine as a guide to good working in gas making, as in almost everything else. We must speak well of the bridge which carries us safely over, and it is certain that gas works routine has all along been the mainstay of the gas industry through the chances and changes which have left their mark on its actual condition.

Alongside, however, and over and above the routine work of keeping gasholders off the ground and paying dividends, there has been during these years with which I am dealing an active living spirit of investigation, study, criticism and innovation which has insensibly changed the face of most of our gas works. It is difficult, to the verge of impossibility, to point to a particular year as witnessing a certain advance, or to ascribe to an individual the credit due to whoever gets more light, heat or power out of a pound of coal than was obtained before. All that we can say is that, looking back upon the British gas industry through the sufficiently long perspective of 19 years, it can be perceived to be a different business from what it was at that period in my own experience. Nor are these changes, these new features, mere details or superficial aspects of what might be the same thing essentially at bottom.

Gas supply is a very much bigger business than it was in 1878. It is not merely that twice the weight of coal has to be carbonized, and that double the quantity of gas has to be provided for the public demands. This is the basis of the problem of modern gas management; but its ramifications are far reaching. Not only has the modern gas engineer to do more, but much that he has to do would not have been regarded as gas engineering at all by his predecessors. These had their own difficulties; and be it far from me to belittle or to disparage the qualities which went to overcome them. But my point is that the gas engineering of the present day has more sides, as well as a broader basis than formerly.

It is a commonplace to say that the gas industry has been stirred to its depths, and awakened to keener life and greater adaptability, by the competition of the electric light. I cannot directly negative this view; but it is only partially true. I take it that the remarkable modern expansion of the gas business is rightly attributable to the large place which the industry holds in the world. There has been so much effort put forth in every direction, for the improvement of every human interest, that it would have been strange indeed if the gas industry had not felt something of the movement. Where so many millions of money are invested, and so many men are employed, there will always be attraction and scope for the ingenious, if sometimes pestilent, persons who will not let things remain as they were in the old time before them.

I am laying emphasis upon this broad view of the course of the remarkable modern expansion of the gas industry, for the reason that it is one which we who are in the center of the movement are seldom able to take. It is but rarely that a practising gas engineer, whose care and attention are necessarily occupied day by day with one pressing detail after another, can take up a position of the necessary degree of detachment to enable him to look round and realize for a moment where he stands—how far he has travelled, and whither his course is tending. Let me, therefore, take this opportunity of recording my opinion that the spirit of a progressive age has been working inside as well as outside the gas industry, forwarding it in correspondence with the increased demands of the community. It is the more important to bring out this truth of the unimpaired vitality of our industry, which has enabled it to correspond so perfectly with its environment, as some of our good friends the electricians have been trying for many years to persuade the world that our business is moribund. We, of course, know better. But this is not sufficient, and it is expedient that the rest of the world should be equally informed of the truth. There is no reason to complain of the view of the gas industry taken by those of the public who have money to invest. Never has gas property stood so high in the estimation of capitalists as during the past year. What we want to attract into our industry, however, is not only money, but intellect, ingenuity, energy and enterprise. We want to convince the world at large that, so far from the industry being on its last legs, it is only at the commencement of a wider career of usefulness; and that in a field of such magnitude and prospects, there is room for all that science and invention can bring into it.

I cannot speak with the knowledge which many of our members now possess of the possibilities of further economies in the production and supply of electric light. What I do know, is that in this respect our older industry retains the characteristics of youth. In the methods of manufacture, in the materials used, and in the products and bye-products resulting from the operations of manufacture and purification, the field open seems broader now than at any previous time and should be as attractive as ever to well-equipped laborers. Nineteen years ago gas making, as I have already observed, was mainly hand work. To this extent it was more a matter of routine, discipline and hard labor, than a problem for the application of mechanical science. The same period saw the birth of the electric lighting industry, which issued, a thing of delicacy and beauty, from the laboratory. No two industries could have had origins more widely different. Gas making was for the half-naked man with the shovel; electricity was the product of the study, elegantly dressed by the mathematical instrument maker.

In my address in 1878, I described, not inappreciatively, the work of M. Jablochkoff, which was then the great novelty in street lighting. The incandescent lamp had not been invented, and I was perforce obliged to confine my criticism of the new systems of lighting to the only illustration of it I could find. It is rather trying to reperuse, in the light of so much subsequent experience, what one has said on such a subject so long ago; but having done so, I find (to my immense relief) that, if allowance is made for the disturbing inventions of those to whom the incandescent electric lamp and its service are due, I was not far wrong in my vaticinations. I formed the opinion then that the electric light would not do more than "touch the fringe of our business." Perhaps I may be pardoned for repeating this sober judgment of 1878, for the sake of contrasting it with the "wild and whirling words" of electrical prophets at the time and since. I also formed the opinion at the same time—which is even now only subject to slight modification—that electric light required two and-a-half times more capital than was needed to do the same amount of work by gas.

To turn, however, from these personal reminiscences to the main argument. These two industries, so different in 1878, are now very near one another at many points. This is due to the influence of mechanical science, which has been brought to bear upon both. The man with the shovel and the mathematical instrument maker have retired into the background; and the mechanical engineer reigns in their stead. In neither industry has practical development during the past 19 years taken quite the turn expected. The physicist has not enabled us to obtain electricity direct from carbon, or to do without conductors. The chemist has not told us how to radically change the old methods of carbonization, nor how to purify gas continuously in closed vessels. Electricity supply stations have, however, become steam power factories; and gas works have been largely remodeled as establishments where heavy materials have to be handled as expeditiously and cheaply as possible by mechanical means.

These considerations lead me to two conclusions, which I must develop a little, at the risk of trespassing on your indulgence. I wish to plead for a closer union of the industries of gas and electricity supply,

in the public interest; and for the fusion of the studies of gas and electrical engineering, in the interest of our profession. It should hardly be necessary to enforce the point; but it is as well to make it clear that my motive in advocating the closer union of gas and electric lighting is not that of safeguarding the interests of the suppliers of gas as monopolists of the lighting trade. There was, undoubtedly, a time when some people thought that gas companies would be well advised to take up electric lighting as a second string for their financial bow. This was done, in point of fact, in many places—notably in the United States. Holding, as I have done from the first, and still hold, that electric lighting will not do more than affect the fringe of the gas business, it is obvious that there would be a contradiction involved in my commending it to gas companies for the sake simply of its income earning capabilities.

Moreover, it is equally obvious that even the fringe of the artificial lighting trade, in such centers as London and the other great aggregations of population at home and abroad, will be enough to fully engage the energies of an independent organization just as the normal annual growth of the metropolitan gas output would be quite large enough to furnish work for a new undertaking on a scale amply sufficient to insure economical production. Without pretending to define the conditions under which independent electric lighting supply may be desirable, I am sure that a very much larger number of cases exist of localities where a limited, but legitimate, demand for public electric lighting must remain unsatisfied unless the service is combined with the local gas supply. This is the true meaning of those numerous electric lighting orders being allowed to lapse, by reason of the local authorities who obtained them—sometimes at considerable expense—not being able to satisfy themselves that they could be carried into effect without loss; and, naturally, the same influences that deter local authorities from carrying out their orders, operate to discourage private undertakers from taking over the responsibility. Here, I do not hesitate to say, the proper solution of the difficulty is to be found in an agreement between the local authority and the gas company, whereby the latter would engage to meet the requirements of the district in the matter of electric lighting—not only, or chiefly, for the sake of direct profit to be made out of it, but in recognition of the fact that they are alone able to do the work without loss. Electric lighting has done gas a service by removing to a large extent the reproach of monopolists from us; but sensible people are less likely now than formerly to be frightened by a phrase, when it is seen how efficiently the interests of the public can be safeguarded by regulation.

Gas companies have shown of late years, by their introduction of prepayment meters and free fittings, that they are able and willing to institute fresh developments of their business which could not possibly pay if they stood alone; and there is nothing but red tape, and a little strangeness in the idea, to prevent them doing as much in a different way for the wealthy and more fashionable element in their districts. It is quite unnecessary here to show how easily this service could be undertaken by many gas companies. This is not the place for discussing in detail questions of whether, assuming the business undertaken, electricity can be best generated at the gas works, or whether gas engines installed in sub stations are to be preferred. Every case must be treated on its merits; my only care being for a better and more general recognition of the principle that the relations of gas companies, local authorities, and the public in this regard might well be modified with advantage to each and all.

This brings me to my second point, which is no more than a plea for the inclusion of electric engineering among the studies of the rising generation of gas managers' assistants, who will in due time become gas engineers and managers themselves. I approach this part of my case with diffidence; knowing as I do how much easier it is to give offence than to succeed in making one's meaning quite clear when one has a complaint to utter. I feel strongly, however, an obligation to speak out in this matter. The question is: Are we attracting into the ranks of our profession the right kind of student—speaking, that is, with reference to what is actually going on in regard to electric engineering? I do not think so.

I am aware, of course, that the industry has within its junior ranks a number of very excellent and promising young men; and I am quite sure that the members of this institution are eminently capable of bringing such pupils and assistants on in the way in which they should go. But what I want to submit to your attention is the circumstance that, as indicated by the returns of the City and Guilds of London Institute—which might be supplemented by inquiry of any leading electrical engineer—the attractiveness of the electrical profession for well educated, well brought-up youths is very great. There is no possibility of a career in it for one-quarter of those who are not only desirous of entering it, but are also perfectly qualified to make a good use of whatever opportunities of advancing themselves may come in their way. Speaking quite generally, these are a different order of youths from those who are attracted into gas works; and I must confess that I am jealous of our friends the electricians in this respect. Depend upon it that, unless there is a good flow of capable men into gas engineering, the status of our profession will not be maintained. One hears from time to time of the miserliness of gas managers' employers; and I fully admit that the salaries attached to too many managerships are scandalously insufficient. At the same time, the electricians are in no better case. The pecuniary inducements they can offer are by no means rich; but yet the very pick of the budding ingenuity of the nation is at their command. We want some of these young fellows too; and the way to get them will be to make room for them in our works and offices. They will come to us as readily as they will go to electric light stations.

I think that in gas engineers' offices, and in every considerable gas works, there ought to be a capable assistant with a knowledge of electrical science. Common prudence dictates this. We, as gas engineers, have already so much to do with electricians, and are fated to have so much more when electrical traction and other applications have their full development, that we cannot afford to have a mere bowing acquaintance with their speciality. Let us try to realize what the responsibilities of the gas engineer in the not distant future are likely to be; and we shall perceive that the best present training cannot be too good for those on whose shoulders the burden will fall. This solicitude for the educational basis of our common profession is no new thought with me. I mentioned this subject in my address in 1878; and my sense of what is wanting in this regard has not been lulled by more recent observation. Our successors in the race must develop, in order to correspond with their larger responsibilities and their more varied cares. Those who cannot or will not do this will be left stranded with ill-paid posts under grumbling employers.

The best way to improve the circumstances and emoluments of any profession is to begin by improving the men who engage in it. This must be done from within, before there is any apparent demand in the employment market for improved quality in the aspirants for appointments. My plea for greater attention to the scientific and technical education of our young men may well be enforced from the point of view of the position which the British gas industry has held, and is to hold, internationally. I am satisfied that there is, on the average, among engineering students in England less thoroughness in the acquisition of scientific knowledge than is the case in some other countries. The British Government takes less interest in the adequate education of its citizens than do the governments of the Continent. The higher technical education is far more costly to the student in England than it is, for instance, in Germany, and is consequently available to a relatively smaller number. But what I think we too often lack—what, if we possessed it, would help to counteract many disadvantages—is the disposition to study, and to follow up investigations for the sake of acquiring thorough mastery; not to be satisfied with one step forward, but to try and make every step a help to further progress.

The laboratories of gas works may well be made more than they are at present the home of research and independent investigation, so that room could be found for men of active intelligence, whose work would result in great gain to the industry, and who would be trained at the early period of life when such training is possible. To the young men themselves, I would say: Let good men, thoroughly furnished, be ready, and place and pay will be found for them. This proceeds from the very nature of the case of an expanding and developing industry. If the gas industry were a failing enterprise, or even an industry which had attained its maximum development, the case would be otherwise.

We are face to face with the specific illustration of the simple truth that, whether with men or things, it is supply that creates the demand; success is fairly certain to those who perceive and apply this.

I have been beguiled so far by this subject, that little time is left me in which even to catalogue the leading developments of our industry which the past 19 years have witnessed. Among these, alterations in the systems of heating and of operating retorts occupy a chief place. I need not refer to the saving of labor and fuel, and to the increased duration of the retorts themselves, which have followed upon the adoption of gaseous firing, save to note that it has been an important factor in the economies which have helped to so materially reduce the price of gas.

The introduction of the system of inclined retorts is an innovation heartily welcomed, and which is having, and will certainly continue to

have, a wide acceptance. It is not necessary I should remind practical gas makers that, while there are many and great conveniences attaching to this system, its possibilities of economy are limited. By its adoption, the proportionate number of workmen employed is greatly reduced as compared with hand labor, and is less even than what is required with an efficient system of mechanical stoking. It is possible, also, to carbonize a larger quantity of coal on the same ground area than with the system still generally prevailing. Further, as has been shown in several cases in England—notably at Messrs. Hardman's works at Harecastle—and also in an admirable model which was shown at the last meeting of this Institution, it is possible to reduce the cost of houses inclosing inclined retorts considerably below their present cost for a given output. The model I refer to was prepared by Mr. Edward Drory, then of Vienna and now of Berlin, whom we have gladly welcomed to-day as a member. He has promised to prepare a paper for our next meeting, dealing with the relative cost of building and operating inclined and horizontal retorts (whether worked by hand or machine) and their efficiency; and his experience will make that contribution of peculiar value.

Bearing in mind to what a low cost the labor in the retort house has been reduced by the work of our Past-President, Mr. Foulis, by Mr. West, and others, the margin for further saving is but small, and would not alone justify large expenditure in reconstruction of works. Where, however, new works or large extensions are required, it will be found, I think increasingly, that this most mechanical and attractive system proves its claim to preference. A very grave question has been raised by one important company, in whose experience it was found that the illuminating value of the gas made in inclined retorts was inferior to that from horizontals, the quantity not being larger. I will not stay to consider possible explanations of such an experience; but may express a hope that when we next meet—if not before—authoritative statistics will be forthcoming as to the facts. We shall probably agree that the most interesting development of our industry in recent years has been the introduction of carbureted water gas. This process of gas making has received so much attention here that I have no intention of dealing with it at any length. By furnishing an economical alternative for enriching ordinary coal gas, and by widening the field from which we are at liberty to purchase coal, it has already conferred very large benefit, not only upon those who have adopted it, but also upon those who have not. It furnishes, in my experience, by far the most economical method of enriching coal gas—indeed, in very many cases, an enriching gas of 22 candles can be made at less cost than the coal gas of, say, 15 candles, which it is desired to enrich. Especially is this experienced where freight is an important element in the cost of material. Having regard to the short period during which the maximum demand upon a gas company's plant continues, it is well to have a plant which can be put into action for a short time, and let down with the minimum of injury. It is also clearly of advantage that such plant shall be erected at the least possible cost. These conditions are met by water gas. Again, the sudden large demands which come at erratic intervals, and are so difficult to provide against by storage, are met by apparatus, which can be brought into use so promptly, and which requires so small a staff of men. The experience of the past five years seems to indicate that very shortly most gas undertakings of moderate size will have installed a carbureted water gas plant—and that, in some degree, independent of consideration of the cost of the product.

Within the last few months there has been a considerable agitation in various parts of the country on account of the assumed danger attaching to the large percentage of carbonic oxide in water gas. It is almost certain that in the belief of most of those who honestly protest against water gas on this ground, the dangerous component is liberated in the process of burning. Coal gas, we have all had occasion to know, is not, when inhaled, as pleasant and health giving as a fresh breeze from the sea; it can be, and often has been, fatal to those who have imbibed too much of it. But the gas is made to burn, not to breathe; and fortunately whether made from coal only or carbureted water gas, or when the latter is used alone, it has an odor which promptly indicates its presence. Because of this odor escaping gas is aparent long before the atmosphere of a room is in a condition at all injurious to health; and the cause can be ascertained and remedied. I suffer no alarm because of any danger attaching to the supply of electric light in my house; yet there are dangers attending careless workmanship with electric wiring which are, I think, greater far than those attaching to gas fitting. Care must be taken in both cases that work is well done.

I heard something while in the United States in 1889 on this question of carbonic oxide from coal gas makers adverse to changing the process they had in use. Yet within a very few years all of them had adopted carbureted water gas wholly or in part; and I believe no fatal case of poisoning by gas has been investigated where the result was traceable to carbonic oxide, or where the catastrophe would not have been the same whatever the character of the gas.

I am tempted to make one further reference to my observations in 1878, because I then ventured on prophecy that in the (then) future gas would be used for "driving a tramway car." It is very gratifying to notice the increasingly successful application of gas to this purpose, which promises to open up a wide demand. In Dessau, and equally successful in Blackpool, a tramway service is being conducted efficiently and very economically with gas as the sole power. In my opinion, founded upon careful observation, this system is the most economical available for suburban traffic and long distance journeys when the road gradients are fairly easy; and gas companies will do well to facilitate its adoption as far as they are able.

These, together with first regenerator and then incandescent burners, prepayment meters, the enormous development of the use of gas for heating, the application of wrought iron and steel to the construction of gasholder guide framing, the suppression of guide framing altogether or the use of ropes in its place, are some further instances of the activity which has characterized the period under review. I feel some confidence that, 19 years hence, the record will be at least as good, and that those who are present at the meeting of this Institution in, say, 1916 will be able still to feel that the end of improvement is not yet.

And now I have only one thing more to say. As I have dealt broadly with the material and with the professional aspects of the gas industry with the sole intent of indicating, by reference to the past and observations of the present, what I think will be the requirements of the future, so now I desire to offer a few words, very diffidently, respecting what I may call the sociology of the industry. My own long and intimate acquaintance with gas workers was consistently pleasant. The company whom I served was desirous of acting the part of a good master; and it was always my inclination to help to realize this aim. This was the epoch already referred to, of the man with the shovel in gas manufacture; and I am old-fashioned enough to regret his steady displacement. So long as he responded to the esteem I entertained for him, I should have been loth indeed to help disestablish him. Whether for good or evil, however, times have changed with the gas worker, as with the rest of the world. The progress of social development is from status to contract; and I have come to see that there was no little of the feudal spirit in the old system of factory organization—when the master had all the say, and the workpeople were supposed to be content so long as they held their peace. Unpleasant as it may be to confess it, I think we must admit that the newly-found desire of the workman to have a part in the ordering of his work, is an illustration of the way of progress just indicated. It is therefore to be reckoned with. Naturally, the first effects of the working of such an influence are rebellions, revolts, industrial wars. These disturbances, however, are incidental and transitory.

I am persuaded there is no returning to the old ways of feudal dependence; and that the easy and the right way to a resettlement of our labor conditions, will be best sought along the line which Mr. George Livesey has indicated by practical illustration, as well as by precept. I am not specially attracted by the name of profit sharing, which does not convey to my mind the idea of a panacea for all industrial ills. I do believe, nevertheless, in demonstrating to the working man, by any and every means that may serve this purpose, the cardinal truth that capital is his best friend instead of, as the Socialists vainly teach, his worst enemy; and I hold that whatever is a realization of this truth, is a question of right and not of favor.

Hence I desire to follow Mr. Livesey's lead, so far as to give to workmen, as we have in so many cases already given to officers, a direct interest in the success of the work by which they live. I would do this, not only by allocating to them (in addition to their ordinary wages) a share—fluctuating with the success of the undertaking—of the gains they can largely influence, but also by giving them, through their elected representatives, a consultative position with regard to the direction of the undertaking. We shall be the better for the workmen's intelligent co operation as freeman in furthering the prosperity of our common employment. To effect this, we must enter into a contract with them; and the clearer it is made that the contract terms are of advantage to both parties, the safer will the engagement be.

I need not say that, in so speaking, I am expressing simply an individual opinion. We are to hear from Mr. Livesey—not for the first time—at this meeting, his views and experience upon this important question. Whether or not we agree with his conclusions, we all admire his courage, and congratulate him upon the success of his efforts; and I think we may count it a distinction for this Institution that one of its members should have brought to such completeness a scheme so successful in the special case where he has applied it, and so full, as I think, of promise for the future harmonious relations of those engaged in every grade of our industry.

[Prepared for the JOURNAL.]

Locating, Determining and Laying of Street Mains and the Distribution of Gas.—No. VIII.

By MR. J. P. GILL.

(See Plates Nos. 10 and 10a.)

District No. (2), has 3 lines of pipes each delivering $\frac{11,500}{3} = 3,835$ cu. ft.

" " (1), " 3 " " " " $\frac{3,500}{3} = 1,170$ "

" " (3), " 3 " " " " $\frac{7,000}{3} = 2,335$ "

" " (4), " 3 " " " " $\frac{1,500}{3} = 500$ "

" " (6), " 8 " " " " $\frac{15,000}{8} = 1,875$ "

" " (5), " 8 " " " " $\frac{3,000}{8} = 375$ "

" " (7), " 8 " " " " $\frac{11,000}{8} = 1,375$ "

" " (8), " 8 " " " " $\frac{2,000}{8} = 250$ "

" " (10), " 7 " " " " $\frac{8,500}{7} = 1,215$ "

" " (9), " 7 " " " " $\frac{1,500}{7} = 215$ "

" " (11), " 7 " " " " $\frac{7,000}{7} = 1,000$ "

" " (12), " 7 " " " " $\frac{1,000}{7} = 145$ "

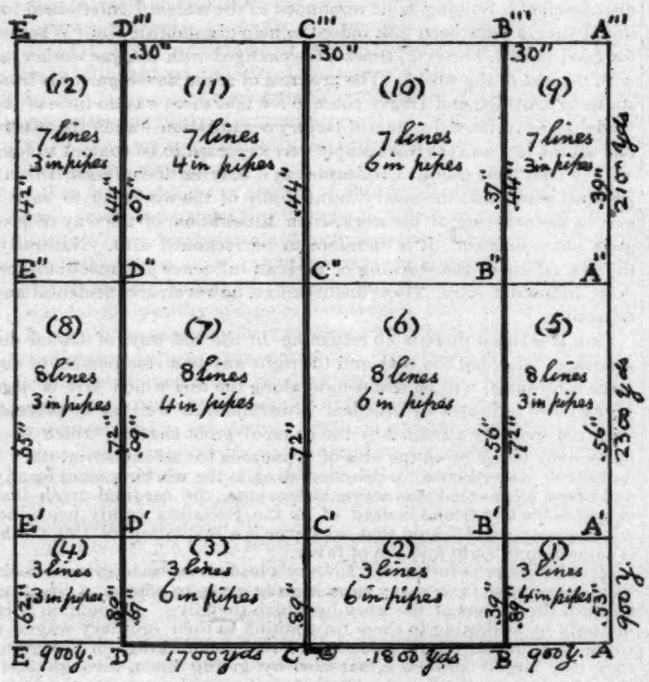

Plate No. 10.—1 Main Supply Pipe.

District No. (2), $D^5 = \frac{.0000003 \times (3,835)^2 \times 2,700}{.93} = 12,809$, requiring 8-inch pipes.

$$f = \frac{.0000003 \times (3,835)^2 \times 1,800}{32,768} = .24 \text{ inch.}$$

.93 — .24 = .69 inch, the pressure at the end of District No. 2.

District No. (1), $D^5 = \frac{.0000003 \times (1,170)^2 \times 900}{.69} = 536$, requiring 4-inch pipes.

$$f = \frac{.0000003 \times (1,170)^2 \times 900}{1,024} = .36 \text{ inch.}$$

.69 — .36 = .33 inch, the pressure at the end of District No. 1.

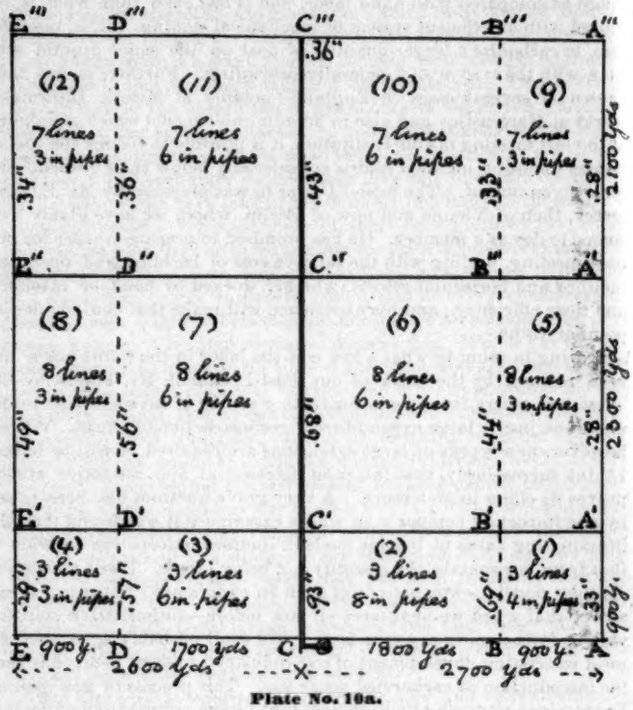

Plate No. 10a.

District No. (3), $D^5 = \frac{.0000003 \times (2,335)^2 \times 2,600}{.93} = 4,573$, requiring 6-inch pipes.

$$f = \frac{.0000003 \times (2,335)^2 \times 1,700}{7,776} = .36 \text{ inch.}$$

.93 — .36 = .57 inch, the pressure at the end of District No. 3.

District No. (4), $D^5 = \frac{.0000003 \times (500)^2 \times 900}{.57} = 118$, requiring 3-inch pipes.

$$f = \frac{.0000003 \times (500)^2 \times 900}{243} = .28 \text{ inch.}$$

.57 — .28 = .29 inch, the pressure at the end of District No. 4.

District No. (6), $D^5 = \frac{.0000003 \times (1,875)^2 \times 2,700}{.68} = 4,188$, requiring 6-inch pipes.

$$f = \frac{.0000003 \times (1,875)^2 \times 1,800}{7,776} = .24 \text{ inch.}$$

.68 — .24 = .44 inch, the pressure at the end of District No. 6.

District No. (5), $D^5 = \frac{.0000003 \times (375)^2 \times 900}{.44} = 86$, requiring 3-inch pipes.

$$f = \frac{.0000003 \times (375)^2 \times 900}{243} = .16 \text{ inch.}$$

.44 — .16 = .28 inch, the pressure at the end of District No. 5.

District No. (7), $D^5 = \frac{.0000003 \times (1,375)^2 \times 2,600}{.68} = 2,169$, requiring 6-inch pipes.

$$f = \frac{.0000003 \times (1,375)^2 \times 1,700}{7,776} = .12 \text{ inch.}$$

.68 — .12 = .56 inch, the pressures at the end of District No. 7.

District No. (8), $D^5 = \frac{.0000003 \times (250)^2 \times 900}{.56} = 30$, requiring 3-inch pipes.

$$f = \frac{.0000003 \times (250)^2 \times 900}{243} = .07 \text{ inch.}$$

.56 — .07 = .49 inch, the pressure at the end of District No. 8.

$$\text{District No. (10), } D^5 = \frac{.0000003 \times (1{,}215)^2 \times 2{,}700}{.43} = 2{,}781,$$

requiring 6-inch pipes.

$$f = \frac{.0000003 \times (1{,}215)^2 \times 1{,}800}{7{,}776} = .10 \text{ inch.}$$

.43 — .10 = .33 inch, the pressure at the end of District No. 10.

$$\text{District No. (9), } D^5 = \frac{.0000003 \times (215)^2 \times 900}{.33} = 38,$$

requiring 3 inch pipes.

$$f = \frac{.0000003 \times (215)^2 \times 900}{243} = .05 \text{ inch.}$$

.33 — .05 = .28 inch, the pressure at the end of District No. 9.

$$\text{District No. (11), } D^5 = \frac{.0000003 \times (1{,}000)^2 \times 2{,}600}{.43} = 1{,}814,$$

requiring 6-inch pipes.

$$f = \frac{.0000003 \times (1{,}000)^2 \times 1{,}700}{7{,}776} = .07 \text{ inch.}$$

.43 — .07 = .36 inch, the pressure at the end of District No. 11.

$$\text{District No. (12), } D^5 = \frac{.0000003 \times (145)^2 \times 900}{.36} = 16,$$

requiring 3 inch pipes.

$$f = \frac{.0000003 \times (145)^2 \times 900}{243} = .02 \text{ inch.}$$

.36 — .02 = .34 inch, the pressure at the end of District No. 12.

These calculations may now be tabulated, but as the method of tabulation has been already shown, and the plates Nos. 10 and 10a exhibit the results clearly, the table may be omitted in this instance.

At the ends of the pipes between A and A‴ (Plate 9a) there are three terminal pressures, .53, .56, .39, the average of which is .49, when there is a full consumption of gas of 60,000 cubic feet per hour. The general average is used because, there being a free and full circulation, the tendency is towards an equality or uniformity of pressure. At this stage, however, a retrospective view should be taken in order to obtain a more comprehensive view of what has been styled the terminal pressure. This is the excess of pressure along the whole line in the district, for which the calculation has been made, above the pressure necessary to do the work; that is to say, to produce the circulation of gas that is needed on that line. Thus the extra pressure at the ends of the pipe in section 5, between A′ and A″, was found to be .56 inch, which is evidently the excess of pressure necessary to produce the circulation of 3,000 cubic feet per hour through the 3-inch pipes. The guiding principle is that the pressure of gas acts and re-acts in all directions, and, therefore, the pressure at the ends, as the result of the calculation, is the surplus pressure throughout the whole line or district, as the case may be. The terminal pressure in District No. (6), between B′ and B″, was found to be .56 inch, which is the excess of pressure above that necessary to produce the circulation of 15,000 cubic feet through the pipes, the pressure at the beginning being .72 inch. These pipes being now connected with the main supply pipe between B and B‴, which is required by the hypothesis, the average excess of pressure will be $\frac{.56+.56}{2}$ = .56 inch over that required for the distribution of the 15,000 cubic feet.

In the same manner we may go through all the districts and find the excess of pressure over that required to produce the needed circulation in them. Thus in Districts Nos. (2) and (1), the average excess of pressure is $\frac{.39+.53}{2}$ = .46 inch; in Districts Nos. (6) and (5), $\frac{.56+.56}{2}$ = .56 inch; for Districts Nos. (10) and (9), $\frac{.37+.39}{2}$ = .38 inch; in Districts Nos. (3) and (4), $\frac{.67+.62}{2}$ = .64 inch; in Districts Nos. (7) and (8), $\frac{.09+.65}{2}$ = .37 inch; in Districts Nos. (11) and (12), $\frac{.07+.42}{2}$ = .24 inch; and it was found that the average terminal or surplus pressure on the three main supply pipes running from south to north was .30 inch. Therefore, the average pressure through the whole town will be $\frac{.46+.56+.64+.37+.24+.30+.30+.30}{9}$ = .39 inch.

In like manner the average pressure (see Plate 10a) through the whole town with one main supply pipe will be .34 inch.

These extra pressures are those in excess of that required to produce an hourly circulation of 60,000 cubic feet, and arise from the fact that the diameters of the pipes as practically used are adopted instead of those exact and unusual diameters called for by the calculations.

The significance of this is, that if a terminal pressure of 1-inch is required, the initial pressure at the holder will have to be increased say two thirds (1.00 — .34 = .66) of an inch, the full initial pressure being then only 1.66 inch. The pressure of 1.66 inch would make (see Plate 10) that at C, .99 + .66 = 1.65 inch; that at C′, .87 + .66 = 1.53 inch; that at C″, .50 + .66 = 1.66 inch; and the average total terminal pressure of all the lines, which is assumed to be a proper one for the consumers at those localities, will be, .34 + .66 = 1 inch. It would be best in all cases to have a general average of pressure above 1 inch, to insure a full and unvarying pressure at the burners; the holder pressure being say 1.80 inch, instead of 1.66 inch.

The difference between the actual working pressure, that is, the pressure that produces the circulation or distribution of the gas, and the surplus pressure, consists in this: The actual working pressure is exhausted when the circulation, or rather the consumption, of gas is taking place, but the excess is what remains of the initial holder pressure, and may be utilized in the manner just explained above.

This illustration shows the advantages of somewhat full final pressures, for the initial pressure may be maintained at a lower point than might otherwise be necessary, avoiding leakages and possibly a weight of holder that might not be needed, and consequently less exhauster power.

The preceding work not having been undertaken with a view only to the scientific or mechanical aspects of the subject, but mainly to the financial results, a comparison of the cost of the pipes and laying them will now be made. The two methods, as shown in Plates Nos. 9 and 9a, and Nos. 10 and 10a, will be first compared.

By Plates Nos. 9 and 9a there are as follows (with 3 main supply pipes):

1,000 yards	24-inch	pipe			=	1,000	yards.	
2,300	20	"			=	2,300	"	
1,800 / 2,100 / 900	12	"			=	4,800	"	
900 / 1,700	10	"			=	2,600	"	
2,300 / 2,300	8	"			=	4,600	"	
								15,300 yards.
2,100 / 2,100	6	"			=	4,200	"	
3 lines	6-inch	pipes,	1,800	yards each.	=	5,400	"	
8 "	6	"	1,800	"	=	14,400	"	
7 "	6	"	1,800	"	=	12,600	"	
3 "	6	"	1,700	"	=	5,100	"	
								41,700 "
3 "	4	"	900	"	=	2,700	"	
8 "	4	"	1,700	"	=	13,600	"	
7 "	4	"	1,700	"	=	11,900	"	
								28,200 "
3 "	3	"	900	"	=	2,700	"	
8 "	3	"	900	"	=	7,200	"	
7 "	3	"	900	"	=	6,300	"	
8 "	3	"	900	"	=	7,200	"	
7 "	3	"	900	"	=	6,300	"	
								29,700 "
								114,900 "

By Plates Nos. 10 and 10a there are as follows (single feed):

1,000 yards	24-inch	pipes			=	1,000	yards.	
2,300 "	20	"			=	2,300	"	
2,100 "	16	"			=	2,100	"	
								5,400 yards.
3 lines	8-inch	pipes,	1,800	yards each.	=	5,400	"	
								5,400 "
3 "	6	"	1,700	"	=	5,100	"	
8 "	6	"	1,800	"	=	14,400	"	
8 "	6	"	1,700	"	=	13,600	"	
7 "	6	"	1,800	"	=	12.200	"	
7 "	6	"	1,700	"	=	11,900	"	
								57,200 "
3 "	4	"	900	"	=	2,700	"	
								2,700 "
3 "	3	"	900	"	=	2,700	"	
8 "	3	"	900	"	=	7,200	"	
8 "	3	"	900	"	=	7,200	"	
7 "	3	"	900	"	=	6,300	"	
7 "	3	"	900	"	=	6,300	"	
								29,700 "
								100,400 "

By Plates Nos. 10 and 10a. Single feed.

1,000	yards	24-inch	pipes at ..	$2.96 per foot	= $8,880.00
2,300	"	20	" ..	2.25 "	= 15,525.00
2,100	"	16	" ..	1.56 "	= 9,828.00
5,400	"	8	" ..	.71 "	= 11,502.00
37,200	"	6	" ..	.50 "	= 85,800.00
2,700	"	4	" ..	.37 "	= 2,997.00
29,700	"	3	" ..	.28 "	= 24,948.00
100,400	"				$159,480.00

By Plates Nos. 9 and 9a. Average pressure.

1,000	yards	24-inch	pipes at ..	$2.96 per foot	= $8,880.00
2,300	"	20	" ..	2.25 "	= 15,525.00
4,800	"	12	" ..	1.08 "	= 15,552.00
2,600	"	10	" ..	.84 "	= 6,552.00
4,600	"	8	" ..	.71 "	= 9,798.00
41,700	"	6	" ..	.50 "	= 62,550.00
28,200	"	4	" ..	.37 "	= 31,302.00
29,700	"	3	" ..	.28 "	= 24,948.00
114,900					$175,107.00
					159,480.00

Difference = $15,627.00

It is manifest, by an inspection of Plate No. 2, that the cost of the street mains will be greater when the gas works are located at A than the estimated cost above made. It will, therefore, not be necessary to go fully into the detailed calculation. By an examination of the above estimates, it appears that the cost is least when the gas works are located at a point at or near the center line of the town and at its lowest grade; and that the cost is least when there is only one main supply pipe, as from C to C‴, than when there are three principal mains by which the gas is distributed to the town, the difference shown above being $15,627. The prices quoted are approximate, and any others may be substituted for them which circumstances may call for.

The terminal pipes, 2,100 yards long each between B″ and B‴, C″ and C‴, and D″ and D‴, may be divided into two lengths, giving two pipes of different diameters, the smaller pipes being the last ones with a less final pressure. Care should be taken, however, to avoid reducing the final pressure to such an extent as to require the branch or district pipes to be of a larger diameter.

It may be helpful to remember that the numerators of the fractions in the equations for finding D^5 and f are the same, except the lengths which vary, unless it should be a final length. The denominator for D^5 is a pressure and that for f is the fifth power of D as adopted.

It is not desirable to have more main supply or feed pipes than is required, because of the higher cost. The quantities of gas discharged by pipes are as the square roots of the fifth power of the diameters.

Now, as an example, $10\ \frac{5}{2} = \sqrt{100{,}000} = 316.228$, and $6\ \frac{5}{2} = 88.18$; $\frac{316{,}228}{88.18} = 3.59$; that is to say, it requires nearly four 6-inch pipes (practically four) to pass as much gas as one 10-inch pipe. The relative cost will be, 1 foot 10-inch pipe = 84 cents, and 4 feet 6 inch pipes × .50 = $2; the 6-inch pipes costing $\frac{2.00}{.84} = 2.38$ times as much as the 10-inch pipe.

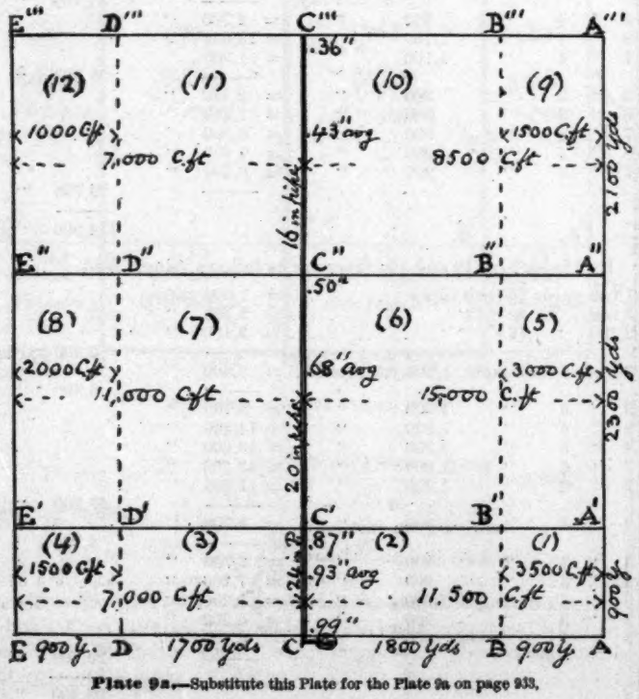

Plate 9a.—Substitute this Plate for the Plate 9a on page 933.

[Prepared for the JOURNAL.]

An Additional Chapter on Inclined Retorts.

By Mr. FREDERICK EGNER.

Permit me to give through the columns of the JOURNAL such further information concerning results with the sloping retorts, which for the reason stated in my recent paper,[1] and also in the course of the discussion of same at the Twentieth Annual Meeting of the Western Gas Association, at Cincinnati last month, I could not give accurately *then*. Having now translated the notes gathered during my recent trip to Europe, the following extracts should interest such members of the gas profession as can appreciate the great progress shown to have been made there, in the business of manufacturing good illuminating coal gas; and, let me remark *en passant*, which, as General Hicklenlooper very ably and truly pointed out at the meeting referred to, is probably the real solution of the fuel gas, or *gas for fuel problem* of the immediate future. Having been commissioned by a well-known St. Louis business man to visit England, France, Germany and Austria to learn of and report on all I could concerning the sloping retort system, I proceeded, first, to Manchester and Salford, visiting there April 3d, 4th and 5th, and again May 4th. My impressions as to the working of the system, having been shown in the paper referred to, only those items then not given will be quoted now. According to the statement of the Engineer and Manager of the Corporation Works, in retorts 18 feet long, on the slope, "D" shape, and 22 ins., by 16 ins. in section, 672 lbs. of coal were carbonized in 6-hour charges.

The same weight of coal could and had been carbonized in 4-hour charges; but because of reasons of no special interest to the reader, 6-hour charges were at that time preferred.

The coal was described as (and seen to be) of poor quality. The make of gas per retort each 24 hours was 12,230 cubic feet; 18,345.6 cubic feet could be and had been made. The retorts were set 7 and 8 to a bench—sevens preferred; 69,813 to 76,100 cubic feet per man employed in the retort house, was the work done; and, then, the men were not more than half employed, as was explained to me. They could have attended to more retorts had they been required.

Huddersfield was visited on April 6th, where, through the courtesy of the Assistant Manager and the General Foreman of the Works, the following figures were obtained: Gas made per retort and day, 15,624 cubic feet. The retorts were 20 feet long, 24 ins. by 13 ins. in section, and set 9 to the bench. The men worked 8-hour shifts, and, per man employed *per shift* (not per man per 24 hours, but per man per 8 hours), 83,228 cubic feet of gas was made. I mean by men employed, those who were working in the retort house exclusively.

Brentford was visited twice, viz., April 8th and 30th. Mr. J. Husband, the very able Engineer, who though not an old man, yet is a man of many years' practical experience in the gas business, was most obliging. The retorts seen were 20 feet by 24½ ins. by 14 ins., and "D" shape, set six to a bench. There were also some sevens, but the sixes were preferred. Formerly 728 lbs. of coal were charged per retort every six hours; but on my most recent visit I understood Mr. Husband to say that he now charged four tons of coal per bench and shift of 8 hours. By that is not to be understood that 8-hour charges are indulged in; rather that the men work in 8-hour shifts, and have 4 tons of coal to dispose of per each bench, or number of retorts equal to one bench, in that time. The make per retort ranged from 13,500 to 20,160 cubic feet in 24 hours. The best make per man, per shift of 8 hours, was over 80,600 cubic feet. At that time to man 96 retorts the following hands were employed: One man on the charging floor, four men on the discharging floor, one fireman, one pipe-jumper, to clear stopped pipes, and one boy to help the fireman and wheel out such coke as was not removed by the wagons, which were hauling it out constantly for sale around the town. Consequently, 7 men and 1 boy, each working 8 hours, were making gas at the rate of 1,935,360 cubic feet in 24 hours. Perhaps, through my fault, there seemed to be some misunderstanding as to the figures given at Cincinnati concerning these particular works. I trust the foregoing will be plain enough and not subject to misunderstanding.

The daylight hours of April 10th, 11th and 12th were spent at Rheims, partly in company of M. Coze. I mention "daylight hours" because I wasted no time sleeping at hotels when I could gain time by traveling and resting while traveling the best one can.

The retorts were found to be about 10 feet 6 ins. by 23 ins. by 14 ins. and "D" shape; 374 lbs. of coal was the charge every 4 hours; the make per retort and day was 10,210.2 cubic feet; and, as the benches

1. See JOURNAL, *ante*, p. 861.

were nines, the make per bench was 91 891.8 cubic feet. The make per man could not be given, because the few men who attended to the drawing and charging of the only two benches used of that system were employed at other work most of the time, and not exclusively at the benches.

Cassel was the next works visited having slopers, on April 13th and 14th. At Cassel, 158,423,298 cubic feet of gas was sold during the year 1896, and as they have no water gas apparatus or other retorts, all was made in slopers. The retorts are set in benches of nines and the make per bench, including all stoppages or time lost, for the year, averages 85,114.21 cubic feet per 24 hours. The coal yields 4.65 cubic feet per pound. The retorts are about 11 feet 6 ins. long. The make per man employed is given as 46,795.55 cubic feet per day's work. These figures were obtained from a copy of the annual report to the city authorities, by the city's Engineer, Herr Emil Merz, who kindly gave me two copies of said document, in addition to much other valuable information concerning the slopers at his works.

On April 14th to 18th, the gas works of Berlin were inspected, and the respective Managers interviewed concerning the subject under investigation. At the works of the "Imperial Continental Gas Association" no slopers were in operation, but 26 benches of nines were in course of erection, as mentioned elsewhere; but at the Municipal works the following results were reported by the General Manager and also by the Engineer and Superintendent of Works of one of these: Yield per pound of coal used, only 4.41 cubic feet, but the yield in both horizontal and sloping retorts was the same as per pound of coal carbonized. The sloping retorts were only about 9 feet 7 ins. by 22 ins. by 13 ins., and elliptical in shape, nine to a bench; the charges were 418 lbs. every four hours. Per man employed doing all the work, except bringing coal (removing the coke, however), *per shift*, 49,771 cubic feet of gas was made. The men worked 12-hour shifts, but were apparently taking things pretty easy. The make per retort in 24 hours was 11,060.28 cubic feet. Now, with the horizontal retorts, heated by similar furnaces, using the same kind of coal, the make per retort was 8,731.80, and per man per shift, 33,992 cubic feet. This was the poorest relative showing as to horizontal and inclined retorts that I found on my whole trip, which may be partly accounted for by the fact that said works was a municipally owned works and that the engineer and other officers—who, without flattery, I can say seemed fully up-to-date in their profession; in a word, very able men—had to accommodate themselves somewhat to the existing conditions and simply do the best one could expect under the same.

April 19th and 20th were devoted to an inspection of the gas works at Dresden. This city, the official home of Herr Baurath Hasse, also owns its gas plant. The retorts and benches being similar to those at Vienna, it was found that, with coal yielding 4.40 cubic feet to the pound, 11,906.40 cubic feet was made per 12-ft. retort, set nine to a bench, in 24 hours. As stated these benches were similar to the earlier installations at Vienna, and having now been much improved, we will proceed to a consideration of the latter.

At Vienna, April 21st and 22d were spent, and all the works visited, as well as the plans of the new great municipal plant seen and explained under the direction of the courteous Chief Engineer and Director for the City, Herr Hermann. At the Imperial Continental Works Mr. Harry Drory, the Chief Manager, to whom the writer had letters of introduction from the principal office of the Company at London, as well as from his brother, Mr. Edward Drory, now at Berlin, was most affable and attentive, in which he was seconded by his Chief Engineer and Assistant, Herr Egeler and Herr Koerting. The following interesting comparative statement of results with sloping and horizontal retorts, though compiled at the Vienna office, were given me by Mr. R. W. Wilson, General (and genial) Secretary of the Imperial Continental Gas Association of London, which Company own not only the Vienna plants, but some 40 odd besides, in the principal cities of Europe. The statement mentioned was a part of a report to be read at the coming meeting of the German Association of Gas and Water Engineers, at Leipzig, and submitted for approval to the principal office of the Company, before publication. It is perhaps needless for me to say that I also first obtained permission to make the figures public, else they would not be given you at this time. Here, then, are the figures extracted from said "Comparative Statement of Cost of Gas made in Sloping and Horizontal Retorts."

First.—10 Coze benches with nine retorts (about) 15 ft. 9 ins. long each: Make of gas per retort and day, 17,658.55 cubic feet; total make of the 90 retorts, 1,589,269 cubic feet; men working 12-hour shifts; and men per shift, 2 men on top, 3 men below—five in all—per shift, with one additional man in each 24 hours for the furnaces, which are clinkered only once in 48 hours; hence, eleven men in all, each 24 hours.

Make per man per working day, 144,479 cubic feet (per 12, *not* per 24 hours.)

It should be remarked here that the coke falls from the retorts directly into the coke yard, and is taken away for sale from that point.

Second.—24 Hasse-Didier generator benches, 9 retorts, about 9 feet 2 inches long; using Foulis stoking and charging machines: Make per retort and day, 8,122.93 cubic feet; make per these 216 retorts in 24 hours, 1,754,553 cubic feet; men required per shift, 4 machinists, 5 helpers, 5 men to remove coke out of the way of machines, 1 fireman; total, 15 men per shift, and 30 men in 24 hours.

Make per man, per day's work, 58,485 cubic feet of gas.

Third.—24 Hasse-Didier generator benches, 9 retorts, about 11 feet 2 inches long, with Foulis drawing and charging machines. These are "through" retorts, hence the coke is discharged through one end of same into the coke yard, as with the slopers, thereby saving considerable labor. Number of men employed per shift of 12 hours: 2 machinists, 8 helpers, 1 fireman, or 11 men per shift, and 22 men per 24 hours. Make of gas per retort and day, 9,182.44 cubic feet; total make with the 216 retorts in 24 hours, 1,983,408 cubic feet; make per man per shift, 90,154.92 cubic feet.

Fourth.—24 Hasse-Didier generator benches, 9 retorts, about 9 feet 2 inches long; manual labor. Men employed, 24 stokers and 1 fireman per shift of 12 hours; total for 24 hours, 50 men. Make per retort and day, 8,476.10 cubic feet; with the whole 216 retorts per 24 hours, 1,830,838.46 cubic feet; make per man per shift, 36,616.76 cubic feet (per 12, *not* per 24 hours).

Calculating the cost of each installation, with wear and tear charges, and 6 per cent. for interest on capital investment, the relative cost per 1,000 cubic feet of gas made will come out in the following proportions, taking the manual labor section as 100.00.

Slopers	39.94
Foulis machine stoking, No. 1	90.01
Foulis machine stoking, No. 2	62.31

And the Foulis apparatus is a very good one, indeed, for the purpose used.

Every experienced gas maker knows that results do not depend upon similarity of apparatus, and that greatly varying yields may be produced by different managers from the same apparatus. This will in part explain the differing results with slopers shown herewith, as obtained at the works quoted; though all are good.

Finally, the writer had the good fortune, through special invitation of Mr. Corbet Woodall, President of the Incorporated Institution of Gas Engineers, to be present at the annual meeting of that Society, held in London on the 5th, 6th and 7th of May, and, during the course of the meeting, the banquet in the evening of the first day of its sessions, and river excursion on the last day, to meet with perhaps most of the representative gas engineers of the United Kingdom, as well as some notable engineers from elsewhere. Interviewing these gentlemen, beginning with Mr. Geo. Livesey, so well and favorably known everywhere, the opinion was, without a single exception, favorable to the good impressions gathered by the writer concerning the sloping retorts. That they will last as long, and possibly longer than horizontal retorts, was conclusively seen. That they cost less per 1,000 cubic feet of gas which they can produce, than any form of horizontal retort, with or without stoking machinery, was asserted and shown in their books by those who had some years experience with both kinds; and that they must result in economy in manipulation anyone's common sense can scarcely fail to point out.

Having spent much time and money on the subject during the past few years, I trust I may now be excused from further explanations, and let those "whom it may concern," viz., the gas profession at large, take up this great improvement, or leave it alone, as their good sense or fancied interests may dictate.

Gas for Power Purposes.

[A paper read by Mr. Jos. Emerson Dawson, Mem. Inst. C.E., before the English Institution of Civil Engineers.]

Gas engines driven with ordinary town gas offer the following advantages compared with steam engines: No ground space for a boiler is required, and no chimney; there is no boiler to clean and repair, and no boiler insurance; there are no clinkers and ashes to remove and no fireman to pay; the gas engine can be stopped or started at will, and there is no loss of fuel during the standby hours. Besides all this,

there is the important fact that there is always a large storage of power to fall back on in the gasholders at the gas works. For intermittent work, such as hoisting, printing, etc., and for moderate powers working constantly, gas engines driven by gas taken from the town mains have such manifest advantages that to a large extent they have superseded steam engines, and will doubtless continue to do so. Almost the only drawback to the use of town gas is its cost, but in some places the day pressure in the mains is too low and gives trouble. It is generally admitted that when town gas costs more than 75 cents per 1,000 cubic feet, the working cost of an engine indicating more than about 30 H.P. exceeds that of a steam engine of the same power, under the usual conditions of regular working.

For larger powers it is now usual to work a gas generating plant in connection with the engine, or there may be several engines served by one gas plant. In such cases the gas plant is to the gas engine what the boiler is to the steam engine. Approximately it occupies about the same ground space as a steam boiler of the same horse power, and the fireman is of the same type in each case. With the gas plant there is no need of a chimney stack; but in towns or where there are adjoining houses it is desirable to have a small waste pipe from the generator carried up above the level of the roofs, so that when the fire generator is blown up after standing, the gases then formed may be blown off without nuisance. The repairs of a gas plant usually cost much less than the cleaning and repairs of a boiler for the same power. The first engine driven with generator gas was in 1879, and since then the adoption of this system of power has spread so rapidly in all countries that it is now quite impossible to estimate the numbers in use. The general outcome is that engines of good make (indicating 50 H.P. and upwards), driven by generator gas of average quality, consume about 1 pound of fuel, whereas good steam engines require 2 pounds to 3 pounds per I.H.P. hour.

An engine indicating about 120 H.P. has been run on test for 5 hours, with an actual fuel consumption of only ¾ pound per I.H.P. On another occasion, with an engine indicating under 33 H.P., the gas plant was placed on a weighing machine, so as to obtain a series of actual records of the weight of fuel converted into power, and even on this small scale of working the fuel consumed was only 1.2 pound per I.H.P. hour.

It may be accepted that gas engines of 50 I.HP. and upwards may be worked under usual conditions, with 1 pound fuel per I.HP.; but it is right to point out that these results cannot be obtained with all kinds of fuel. For heating furnaces and other such work, generator gas can be made with bituminous coal, but for engine work gas so made carries too much tar and other impurities. To avoid this trouble the generator gas used for engines is made with anthracite coal or coke. The price of the small anthracite is $1.50 to $1.75 a ton at the pits in South Wales and near Glasgow, and for the south and west of England, and in most parts of Scotland, the cost of this coal delivered is about the same as that of steam coal. In the Midlands and northern counties it costs more, and then local coke is used.

Lately Dr. Mond has been working a gas plant with bituminons coal, and in his special treatment of the gas it can be used for engine work, but at present he can only work his process continously, night and day, in a plant capable of serving not less than 2,000 I.HP., so that for ordinary purposes it is not suitable. It is tolerably certain that sooner or later engines will be worked with bituminous coal; but without waiting for that particular result, the fact remained that great economy is already effected by using anthracite or coke.

Another important feature of gas is that it does not condense or lose power on its way to the engine; on the contrary, the more the gas is cooled, the better it is for the engine, as each charge of gas which enters the cylinder is more dense, and has consequently greater energy. With steam the reverse is the case; there is also trouble with leaks in the piping, but with gas there is no such trouble, as the pressure is low. One result of being able to convey gas any distance in pipes, without deterioration, is that there can be a separate engine in each department of a large factory, with light shafting for each. It is no longer necessary to have heavy shafting to drive the whole of a mill or factory from engines placed near the boilers.

The electrical transmission of power in shipyards and other works covering a large area is now being adopted extensively, and in this way some of the loss from condensed steam is avoided. But the power for driving the dynamos still has to be provided, and the most economical is gas power. One of the leading firms on the Clyde is now putting in a large gas plant for this purpose. There are also several instances of gas power being used for electric lighting, as well as for pumping water, pumping sewage, etc.

The stand-by loss of a steam boiler is considerable, whereas that of a gas generator, capable of serving 200 H.P., is only 3 pounds to 5 pounds per hour.

As to the fuel consumption of steam engines, it is usual to say that non-condensing engines require 2 pounds to 3 pounds coal per I.H.P., but it may be well to remember the words of Sir F. Bramwell in his presidential address in 1885, concerning engines working under ordinary practical conditions:

"In an investigation instituted last year by the Corporation of Birmingham, when considering whether they should approve of a proposal to lay down power-distributing mains throughout their streets, it was found, on indicating some six non-condensing steam engines taken indiscriminately from among users of power, and ranging from 5 nominal H.P. up to 30 nominal H.P., that the consumption in one instance was as high as 27.5 pounds, while it never fell below 9.6 pounds, and the average of the whole was as much as 18 pounds."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

"Western Observer," writing from Chicago, under date of the 11th inst., says: "The Illinois legislative bill permitting a consolidation of the gas interests of Chicago, has not made much of a flurry in local gas circles. The Board of Aldermen and the City Council, however, are trying to force through a blanket gas ordinance, the provisions of which will be in effect before July 1st, the date on which the bill allowing consolidation becomes legal.——The Galesburg (Ills.) Gas and Electric Light Company is constructing a new holder.——The extremely cold weather that has so far prevailed in the West during May and June has curtailed this season's gas stove trade most woefully."

Important main extensions are being made by the Wichita (Kan.) Gas, Electric Light and Power Company.

A summary of the Illinois Senate Bill, No. 400, introduced by Mr. Crawford, which passed both houses and finally received the indorsement of Governor Tanner, is as follows: It prohibits City Councils and Boards of Trustees from passing an ordinance granting to any person or corporation the right to lay any gas pipes for the distribution of gas for fuel or lighting purposes, or the putting in of wires for the conveying of electric currents, except upon the petition of the owners of the land representing more than one-half the frontage of the street or alley, or so much thereof sought to be used, and when the street sought to be used is more than a mile in length, no right or privilege to lay pipes or string wires for lighting purposes shall be granted unless a petition therefor shall be presented to the Council or Board of Trustees signed by the owners of land representing more than one-half the frontage of each mile and of the fractional part of a mile of any in excess of the whole miles.

The Connecticut Legislature has granted the projectors of the Milford Gas and Electric Light Company an extension of time (to July 1, 1897) for the organization of that Company.

The Connecticut Legislature has also acceded to an amendment of the charter of the Derby Gas Company, of Birmingham, under which the Company may increase its capital stock to $500,000.

Mr. K. L. Cowgill has been appointed to the vacancy on the staff of the Dover (Del.) Gas Company occasioned by the death of Mr. George P. Jarrell.

An oil storage tank (capacity 60,000 gallons) is being constructed by the Capital City Gas Light Company of Des Moines, Iowa.

At a meeting of the shareholders of the San Mateo (Cal.) Gas Light Company the following officers were chosen: Directors, Julius Wiesender, John Morton, W. S. Jack and W. H. Barrows, and Mrs. Ellen C. Morton; President and Treasurer, John Morton; Vice-President, Julius Wiesender; Secretary, W. S. Jack.

Articles incorporating the Fulton and Oswego Falls (N. Y.) Gas Company have been filed. The objects stated are "to manufacture and supply gas for lighting and fuel purposes in the county of Oswego." The capital stock is put at $45,000, and the Directors for the first year are: Thomas D. Lewis and Jonathan H. Case, of Fulton, and George A. Edwards, of Syracuse.

A correspondent forwards the following: "Proceedings have been instituted by the Board of Water Commissioners to acquire by condem-

nation the property of the Le Roy (N.Y.) Light Company, which operates and owns both the electric and gas plants. At a special meeting held March 30th the voters and taxpayers decided, by a majority of 35, to take over, for operation on public account, the electric light plant and it has since been determined that the gas plant must also be included in the purchase. On the 16th inst. application was made in Special Term, Supreme Court, at Buffalo, for the appointment of a commission of three members to determine the price that shall be paid for the properties named."

THE Montreal (Canada) *Star*, of the 10th inst., says: "A judgment of importance to all consumers of gas has been given by the Hon. Judge Purcell, in the Circuit Court. The case is that of Mr. F. E. Gilman against the Montreal Gas Company, and the judgment condemned the latter to fulfil an agreement to furnish the plaintiff gas at 95 cents per 1,000 cubic feet. This was an action brought by Mr. F. E. Gilman in February, 1895, against the Montreal Gas Company to recover the sum of $24.75, which sum was the overcharge in the gas bills ($14.75) for February, and $10 damages. The plaintiff, through his attorney, Mr. W. A. Weir, contended that the Gas Company was obliged to furnish him gas at his residence, No. 111 St. Matthew street, at 95 cents per 1,000 cubic feet, and one meter free of rent, in accordance with the terms of its circular sent out to the residents of the city on May 30th, 1894, as follows: '*Reduction in Price of Gas.*—F. E. Gilman, Esq., 111 St. Matthew street: Sir—I beg to inform you that all gas supplied to you since the 1st inst. at the above address will be charged at the same rate (if not lower) as that of the Consumers Gas Company, and the use of one meter will be given free. I am, sir, your obedient servant, W. W. MOORE, Secretary.

"'THE MONTREAL GAS COMPANY, Montreal, May 30th, 1894.'

This circular was signed by the Secretary of the Gas Company, and under its provisions the Gas Company furnished gas to Mr. Gilman and other residents of the city at 95 cents per 1,000, until it had absorbed the Consumers Company. When the Gas Company had bought out the new Company, it immediately raised its rates to $1.10 and $1.40 per 1,000, less a cash discount. When plaintiff received his first bill for gas at the increased rate in February, 1895, he paid the same under protest, and immediately instituted a suit to recover back the amount charged him over 95 cents per 1,000. The Gas Company pleaded that it had an agreement with the city permitting it to charge the larger sums, and contended that by giving notice to the consumers that it was going to charge the increased rate entitled it to do so. The Court held, however, that the Company was obliged to furnish Mr. Gilman gas at the rate of 95 cents per 1,000, as mentioned in the circular, and that the notice which the Company was alleged to have sent to the plaintiff, notifying him that the price had been increased was not proven. Judgment was accordingly rendered for the full amount of the overcharge, $14.75, but the damages of $10 claimed were not allowed. Mr. Gilman has, in accordance with the terms of his judgment, instituted another action to recover from the Gas Company all amounts charged him over 95 cents per 1,000 since the date this suit was instituted, February, 1895."

THE officers chosen to manage the affairs of the Milton (Pa.) Gas Company for the ensuing year are: President, John Jenkins; Secretary and Treasurer, W. J. Scott; Superintendent, James R. Chapin.

DAMAGE to the extent of $600 was recently occasioned by a fire in the plant of the Youngstown (Ohio) Gas Company.

THE following is from the Philadelphia *Ledger*, of the 12th inst.: "The affairs of the Bay State Gas Company, of Delaware, have given rise to a good deal of litigation during the past few months, both in Wilmington, Del., and in the city of New York. In October last Judge Wales appointed receivers at the suit of Wm. Buchanan, and their appointment was confirmed in this and other cities, but a settlement was soon effected and the receivers were discharged. It turned out that $275,000 had been paid to the plaintiff and receivers for the settlement of the case, a note for $50,000 having been given as a part of the settlement. Payment of this note was refused by the makers, who had been the financial agents of the Company in the city of New York, and upon suit brought the facts were developed. Immediately after the discharge of the receivers another suit was brought by Godfrey Morse and others, of Boston, in which certain Philadelphia parties intervened. Sundry motions have been made before Judge Dallas in this suit, and upon the 21st of last month an argument was heard by Judge Dallas, at Wilmington, upon a petition to vacate the discharge of the receivers and to reinstate the bill. This application was argued by Messrs. Bartlett and Johnson, of Boston, for the petition, and by Mr. Benton, of Boston, and Senator Gray in opposition. The following day, to suit the convenience of counsel, Judge Dallas heard an argument in this city upon the demurrer to the Morse bill, which was argued at great length by Mr. Benton and Senator Gray for the demurrer, and by Mr. Tower, of Boston, and Mr. Dickson, of this city, in reply. Judge Dallas has recently disposed of both applications, refusing to reopen the Buchanan suit, upon the ground that the petitioner had become a party complainant to the Morse suit, and overruling the demurrer to the Morse bill, and requiring the defendant Company to make answer, filing the following opinion:

"'This suit is brought by some of the holders of income bonds of the corporation defendant, on behalf of themselves and all other holders of like bonds. In and by these bonds it was provided that the interest should be paid out of the net earnings, and that if in any year there should be no net earnings, no interest should be paid. They also provided that such net earnings are to be only such part of the income of said Company as would be applicable to the payment of dividends on its capital stock, and they shall, in all events be reserved and applied exclusively to the payment of said interest before and in preference to any payment on account of any other obligation of the said Company disposing of the said net income, the intention of these presents being to make the payment of said interest a first charge or lien upon the said net earnings to the extent aforesaid. No interest has been paid since May 1, 1893, and the bill alleges that the successive defaults which thereafter occurred were occasioned by certain dispositions of the corporation's assets which are charged to have been misappropriations, and by certain things done by it which are charged to have been done in fraud of the bondholders' rights. It is not necessary to pass upon any question concerning the interests of any person or persons who are not parties to this proceeding; but, as against the defendant itself, the plaintiffs have presented a case which I think entitles them to discovery by answer and through an accounting in equity, and their title to any other or further relief need not now be considered. As regards the corporation which issued these bonds, their manifest meaning is conclusive as to their effect. The undertaking not to make any payment of any other obligation disposing of net income until payment of the interest on the bonds should first have been made, and the expression of intent 'to make the payment of said interest a first charge or lien,' would be nugatory and delusive if, as defendant contends, the only remedy for any contravention of this provision were an action at law, inasmuch as an action for the breach of a naked promise to pay would be quite as efficacious. Moreover, not only was it provided that the payment of the bond interest should be a first charge or lien upon net earnings, but also that said interest should not be payable except out of net earnings. Surely, then, the holders of these bonds are entitled to know whether there have been net earnings, and, if there have not been, whether their absence is attributable to a failure on the part of the defendant to discharge any duty which it owed to the plaintiffs. But again it is contended that no duty was assumed with which a court of equity is competent to deal; that what is set up amounts to but a breach of contract. I cannot assent to this. Those who took these bonds did not, as has been pointed out, accept mere promises to pay. They, of course, relied, and had a right to rely, upon the fidelity of the corporation for the production, protection and application of net earnings, and by its necessarily implied undertaking to exercise good faith in this regard the corporation assumed an obligation which was fiduciary in its nature, and which, therefore, is of equitable cognizance. My views upon the point which was mainly pressed upon the argument have been briefly, but I think sufficiently, indicated. The several additional objections urged against the bill have also been considered, but none of them can be sustained. The defendant's demurrer to the bill of complaint is overruled.'"

THE authorities of Dallas, Texas, are not disposed to grant a franchise for a fuel gas company in that city. The Hall process, it is understood, was the one which the promoters favored.

THE San Leandro Gas and Electric Light Company's plants have been leased to Mr. G. T. Thompson for the period of one year. Mr. J. E. Quinn will continue to act as Superintendent.

MR. A. P. WEST, Secretary of the Passadena (Cal.) Consolidated Gas Company, has notified the shareholders that an assessment of $8 per share has been levied, which assessment is payable on or before July 3d to Mr. West, at his office in the Columbia Savings Bank, 258 South

Spring street, Los Angeles. All stock upon which the assessment has not been paid will be sold at public auction, July 24.

Mr. Frederick H. Shelton, writing to the Journal under date of the 14th inst., says: "In my recent paper upon "Fuel Gas," read at Cincinnati before the Western Gas Association, I quoted an analysis of gas as made by the Harris process, which, while very unsatisfactory from its apparent incorrectness, was yet the only one that I had seen published and that I could get. Since then Mr. H. L. Payne, Chemist, at Cleveland, Ohio, has very courteously furnished me with a copy of analyses made by him January, 1893, at Connersville, Ind. I herewith inclose an average of the same, thinking that you may care to publish it in order that an accurate analysis of the Harris process may be on record."

The figures appended represent an average of the separate analyses of 5 samples of Harris gas, taken at Connersville, Ind., January, 1893, by Mr. H. L. Payne, of Cleveland, Ohio:

Hydrogen	8.5	per cent.
Carbonic oxide	17.9	"
" acid	3.0	"
Marsh gas	9.5	"
Illuminants	7.1	"
Oxygen	0.3	"
Nitrogen	53.7	"

The proprietors of the Camden (N.J.) Gas Light Company deny that they intend to extend their main pipes to the borough of Merchantville.

At the annual meeting of the Reading (Pa.) Gas Company the following Directors were elected: Horatio Trexler, Chas. Breneiser, E. D. Smith, W. A. Arnold, Isaac Hiester, Wm. R. McIlvain and Jno. J. Kutz.

The shareholders of the Buffalo (N.Y.) Mutual Gas Light Company have assented to the proposition to increase its capital stock to $3,000,000 and to issue a bonded indebtedness of $3,000,000, as per the outline submitted in the Journal for last week. Something over 6,000 shares out of a total of 7,500 shares voted in favor of the increase.

At a called meeting of the Lynchburg (Va.) City Council, held the afternoon of the 12th inst., a franchise was granted to the promoters of the Lynchburg Light and Heat Company to construct and operate a plant for the manufacture and sale of gas for manufacturing, illuminating and heating purposes, and for the locating and laying of mains for the distribution thereof. By the terms of the contract the gas is to be furnished to residents at a sum not to exceed $1.35 per 1,000 cubic feet for illuminating purposes; for fuel and manufacturing purposes at a price not to exceed $1 per 1,000 cubic feet. The Company is to commence the work of constructing its plant within 4 months from the date of the franchise, and shall complete the same within 10 months from the said date. Before the Company begins work on any of the streets of the city, it will be required to give a bond in the penalty of $10,000, conditioned for the faithful performance on its part of the stipulations and provisions of the contract. The sum of $300 per annum is to be paid by the Company for the privilege of using the streets, highways, etc., as provided for.

The reputed backer of this concern is Mr. W. J. Payne, of Richmond, Va., and it is proposed to distribute acetylene gas.

Mr. William H. Whiteley, for many years in the employ of the South Boston (Mass.) Gas Light Company, died at his home, 139 Dorchester street, South Boston, on the morning of the 10th inst.

The Council of Newburyport, Mass., adopted an order instructing the Mayor to appear with the City Solicitor and Lighting Committee before the Board of Gas and Electric Light Commissioners, and petition the latter for an order directing the Newburyport Gas and Electric Company to reduce its selling rates.

The following officers have been named to direct the affairs of the Dunmore (Pa.) Gas and Water Company for the ensuing year: President, George B. Smith; Secretary and Treasurer, Henry Beyea; Assistant Secretary, T. J. Frear.

The proprietors of the Houston (Tex.) Gas Light Company have refused to accept the new franchise offered them by the local authorities. The main objections are that the time limit fixed (15 years) is too short, and that the rate named ($1.50 per 1,000 cubic feet) is too low.

A New Method of Setting Water Meters.

[Read by Mr. George Cotter before the American Water Works Association.]

The report of your committee last year on "Best Method of Setting Meters" revealed that there was no general method, and that all the plans proposed had some objectionable features. The very general plan mentioned of setting meters in the cellar or basement, while no doubt being the least objectionable of all, yet possesses all the drawbacks accorded it by the report, and several more not mentioned. The absence of the tenants, terrors of the coal pile, vicious dogs and surly tenants are good objections, but they are not all of the disadvantages of this plan, as most of the members here can testify.

The deep pit in the sidewalk commends itself as being accessible at all times, but in cold climates it must be deep, and the meter thoroughly covered to prevent freezing. Then, too, the pit must be large enough to permit of the meter being connected or disconnected, and this makes it expensive, especially if constructed with reference to durability and permanence.

At that time your committee reported: "From careful investigation it seems that no general plan or place of setting meters could be recommended for all sections." Now I have the pleasure of reporting to this Association and the gentlemen present that this is not necessarily correct now. During the past year I have been testing a method of setting meters, which I can honestly say fills all the requirements in all climates and under all conditions. I have had several of these boxes in use during the past winter, and although the winter was an unusually cold one, there was not the least sign of freezing. On this point I feel that I cannot enlarge too much.

The past winter has been a hard one for us, and we had a number of meters freeze and burst that had successfully passed through several winters, and I thought I had them well protected. The mercury was as low as — 18°, and frequently down to 10 or 15° below zero, but there was no sign of freezing in the meter boxes, as could easily be observed, as there was a little water left in the bottom of the boxes. The reason the meters did not freeze was due to the small diameter of the box (10 inches), as the meter was not covered in any way except by the lid of the box.

The box is simply a cylindrical cast iron tube with a bottom and a top or lid. The bottom is preferably water tight, and the lid is also packed and locked with a five-cornered screw the same as used in curb boxes. The connections to the meter are slip joints packed with a rubber ring, which is slipped into a groove in the end of sockets which are attached to the inlet and outlet of the meter. Projecting up in the bottom of the box are two taper nipples to which the service is attached. After the box is attached to the service and filled in and the meter provided with sockets and an extension dial, the process of attaching and detaching the meter is very simple and quickly done.

All that is necessary to connect the meter is to take it by the top of the extension and lower it into the box and press it down on the taper nipples in the bottom. You can then turn on the water and the meter is ready for business. To read the meter, you simply remove the lid of the box, which is small and handy. To remove the meter, you simply shut off the water and pull it out of the box.

Nothing could be plainer or simpler than this box and the method of connecting the meter, and I am confident that all of the worst objections to other methods have been overcome and all their good points absorbed by this device. The cost of the boxes used by our department was $5 and the cost of the setting $1.05, while a good brick pit with iron frame and lid costs us about $10 to $12. It will thus be seen that the meter box is cheaper, and besides is much to be preferred.

I also found that on the average it cost almost as much to connect meters in cellars as it did to use the box, and especially where the meters had to be covered to prevent freezing. The advantages of this box are numerous, among which may be mentioned, that being at the curb there is no danger of connections being made between the meter and the main, and it is convenient for attaching pave washers, lawn sprinklers, etc. It is especially accessible at all times. The meter can be easily and quickly attached or detached or another substituted without the use of any tools whatever. The meter can be set at the same depth as the service pipe and there is no danger of freezing.

The Market for Gas Securities.

The upward movement in the general share market seems to have at last touched gas shares, and the result is nothing short of buoyancy. The advance in Equitable is well maintained, 228 being freely bid for it, but no stock of moment has changed hands despite the great advance which these figures mean over those quoted a month ago. The quotations for New York and East River are somewhat easier to-day (Friday), the opening having been made at 74 to 75¼, which is quite a bit below the high figure for the week; nevertheless, to day's quotation discloses an advance of 11 points in the bid price as the net result of the week's trading. Mutual is steady, at 250 bid, and Standards are something better than even was shown by the high prices of last week. Consolidated shared in the advance, the opening to-day having been made at 167 to 167½, with every indication that it was on its way to making a record price for it—the record being just this side of 170. Buy Consolidated, is our advice; for no mistake can be made through such purchasing.

Brooklyn Union is 108½ bid, and the bonds have crossed 113. Bay State is firmer, and is sure to go considerably over current prices. Chicago gas crossed 90 to-day; at noon the quotation was 91. This is the best price made in Chicago since the winter of 1893. It looks to us that it is pretty near its maximum value just now. Western, of Milwaukee, is very strong, having crossed the 70 mark, and Baltimore Consolidated is in good demand, at 56 to 57.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

June 21.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,480,000	100	167	167¼
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	228	230
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	250	253
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	74	75¼
Preferred	2,000,000	100	106	107¼
Bonds 1st 5's	3,500,000	1,000	114	115
" 1st Con. 5's	1,500,000	..	107⅝	108⅛
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	112	113¼
Preferred	5,000,000	100	122	124
Bonds, 1st Mortgage, 5's	1,500,000	1,000	113	116
Yonkers	299,650	50	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	108¼	108¾
" " Bonds (5's)	15 000,000	1,000	113	113½
Bay State	15,000,000	50	1¾	1⅞
" Income Bonds	2,000,000	1,000	..	35
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	80	.
2d " " "	3,000,000	1,000	61	..
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	90⅝	90¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	104	104¼
Columbus	1,000,000	..	77¼	78x
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	101	103
Cincinnati G. & C. Co.	8,500,000	100	201½	202
Consumers, Toronto	1,800,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	56	57
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400,000	..	..	..
Detroit	4,000,000	.	22	..
" Con. Bonds	4,312,000	..	73½	74
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	88
" Bonds	2,000,000	..	89	92
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	143	143
" Bonds, 6's	2,650,000	..	104	106
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	84	88
Bonds	1,000,000	1,000	92	95
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	23	24
Preferred	2,500,000	100	78	80
Bonds	9,084,400	1,000	99	100
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	235	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10.000,000	100	94	94¼
St. Paul Gas Light Co.	1,500,000	100	79	81
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	70½	71
Bonds, 5's	3,556,000	.	95½	96
Wilmington, Del.	550,000	50	200	202

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DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO.,
DREXEL BUILDING, PHILA., June 9, 1897.

The Directors have this day declared a dividend of twenty (20) per cent., payable on June 25th, 1897, to stockholders of record at the close of business June 18th. Checks will be mailed.

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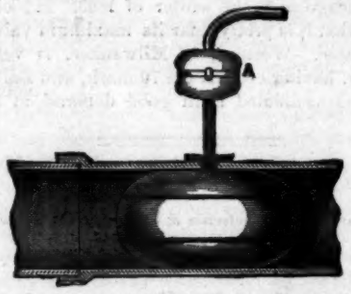

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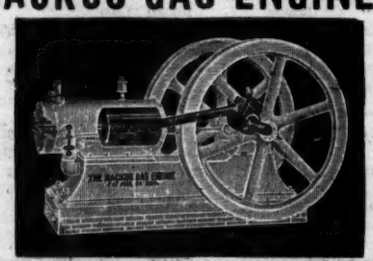

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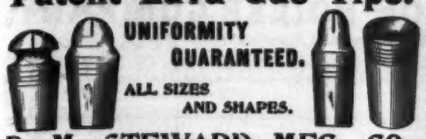

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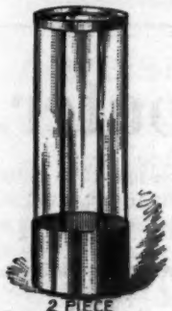

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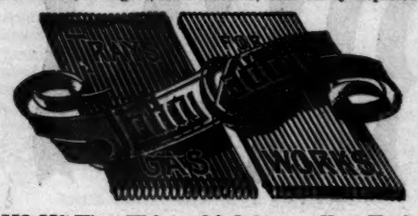

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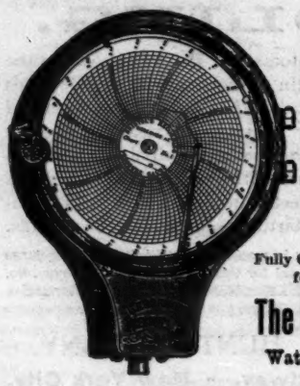

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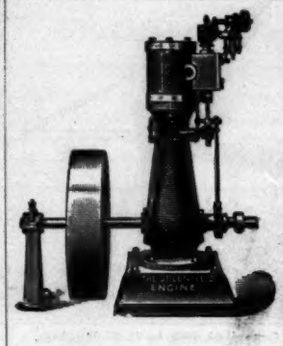

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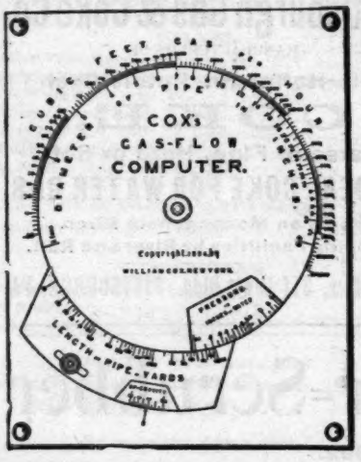

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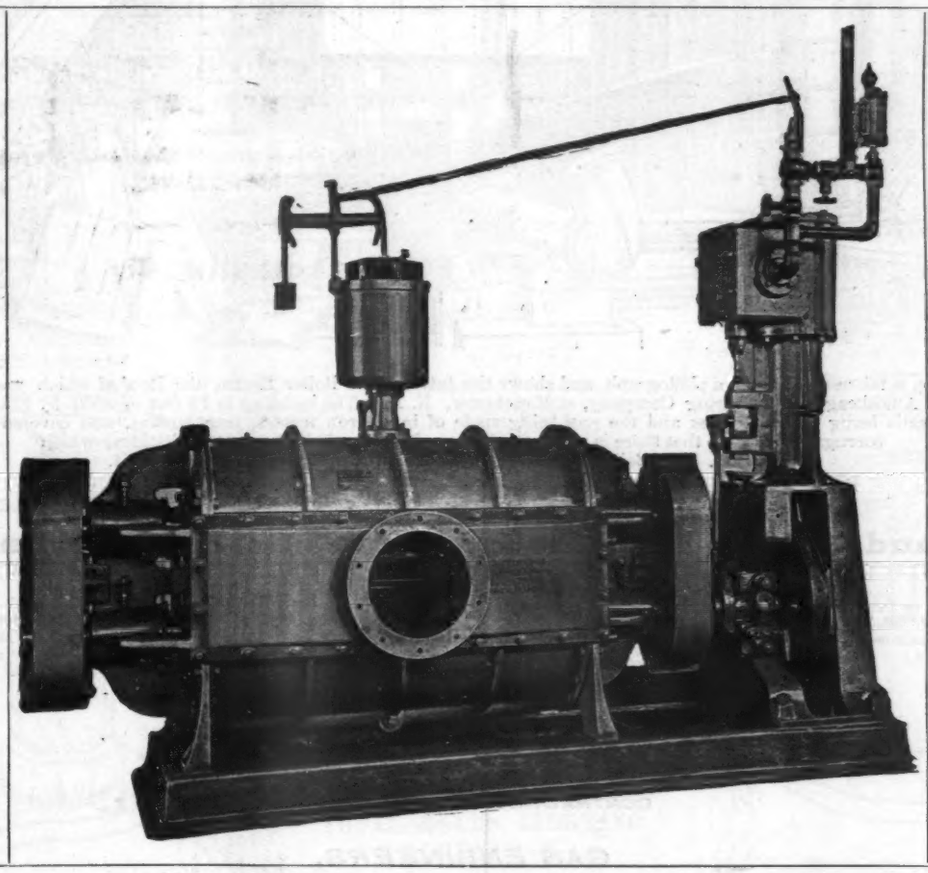

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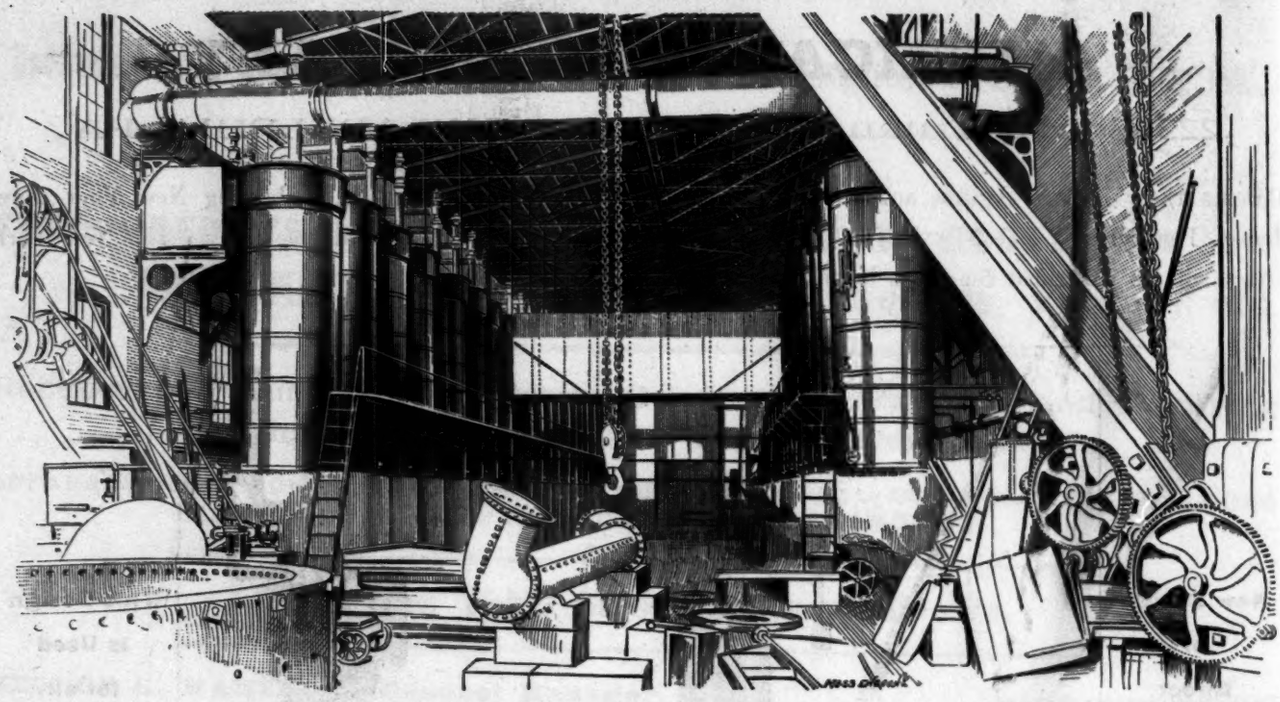

The above illustration is taken direct from a photograph, and shows the interior of a Boiler House, the Roof of which was designed and buil by us for the Amoskeag Manufacturing Company, at Manchester, N. H. The building is 75 feet in width by 275 feet in length, the walls being made of brick and the roof being made of iron—iron trusses, iron purlins, and covered with corrugated iron—so that there is absolutely no woodwork anywhere about the building which can take fire. For Boiler Rooms this construction particularly commends itself.

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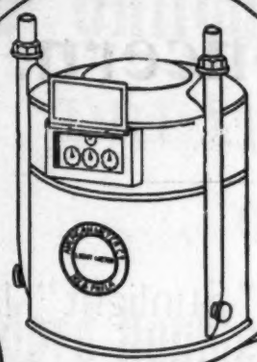
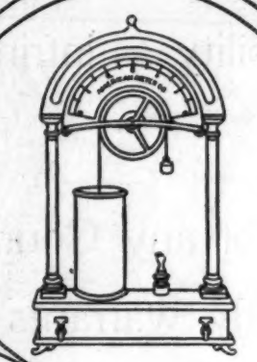
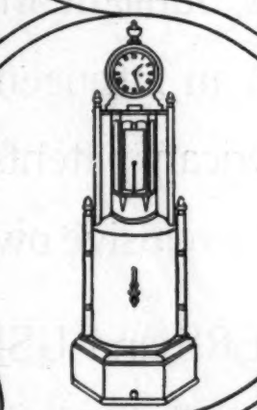
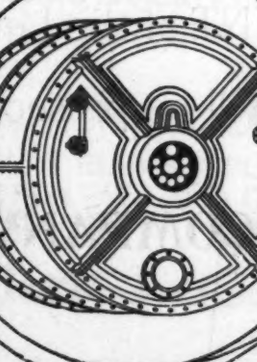








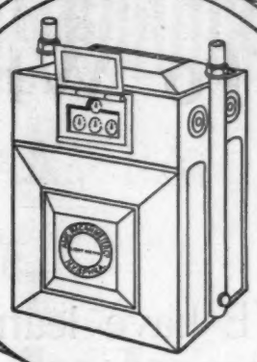
PUBLIC LIGHTING TABLE.

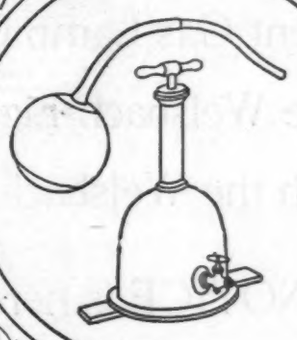
JULY, 1897.

Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extingnish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguist.
				P.M.	A.M.
Thu.	1	8.00 PM	3.30 AM	7.30	3.15
Fri.	2	8.00	3.30	7.30	3.15
Sat.	3	8.00	3.30	7.30	3.15
Sun.	4	9.10	3.40	7.30	3.15
Mon.	5	9.40	3.40	7.30	3.15
Tue.	6	10.00	3.40	7.30	3.15
Wed.	7	10.30 FQ	3.40	7.30	3.15
Thu.	8	11.00	3.40	7.30	3.15
Fri.	9	11.40	3.40	7.30	3.15
Sat.	10	12.30 AM	3.40	7.30	3.15
Sun.	11	1.30	3.40	7.30	3.15
Mon.	12	No L.	No L.	7.30	3.15
Tue.	13	No L. PM	No L.	7.30	3.15
Wed.	14	No L.	No L.	7.30	3.15
Thu.	15	8.00 PM	9.30 PM	7.30	3.15
Fri.	16	8.00	10.00	7.20	3.15
Sat.	17	8.00	10.30	7.20	3.15
Sun.	18	7.50	10.50	7.20	3.15
Mon.	19	7.50	11.10	7.20	3.15
Tue.	20	7.50	11.30	7.20	3.15
Wed.	21	7.50 LQ	12.00 AM	7.20	3.15
Thu.	22	7.50	12.30	7.20	3.15
Fri.	23	7.50	1.00	7.20	3.15
Sat.	24	7.50	1.50	7.20	3.15
Sun.	25	7.50	2.40	7.20	3.15
Mon.	26	7.50	4 00	7.20	3.15
Tue.	27	7.50	4 00	7.20	3.15
Wed.	28	7.50	4.00	7.20	3.15
Thu.	29	7.50 NM	4.00	7.20	3.15
Fri.	30	7.50	4.00	7.10	3.30
Sat.	31	7.50	4.00	7.10	3 30

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45





To Whom It May Concern.

WE have learned that the makers of the "Sunlight" lamp assert that there has been a decision in the English Courts which saves them and their customers from liability as infringers of the Welsbach patents.

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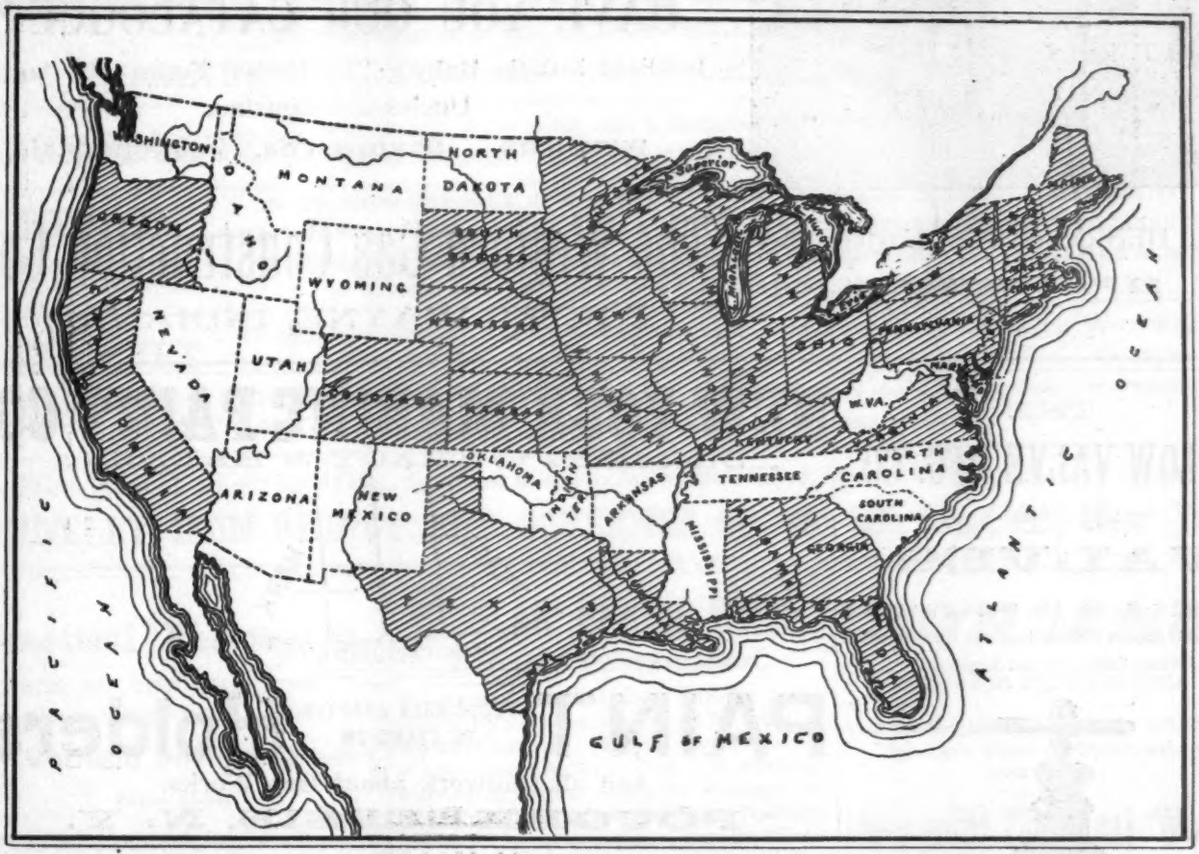

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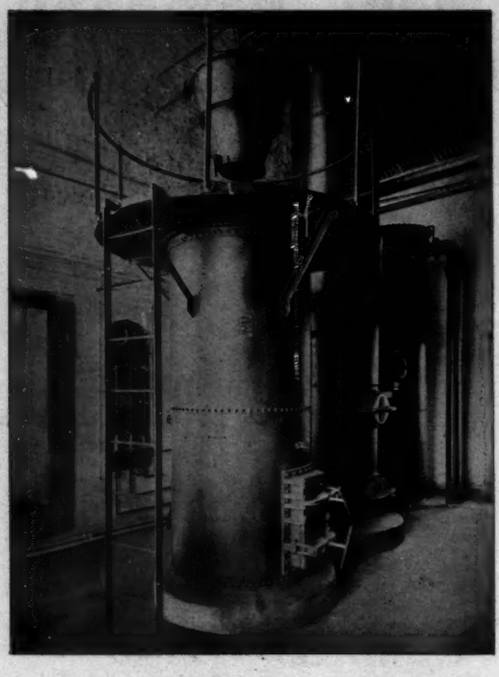

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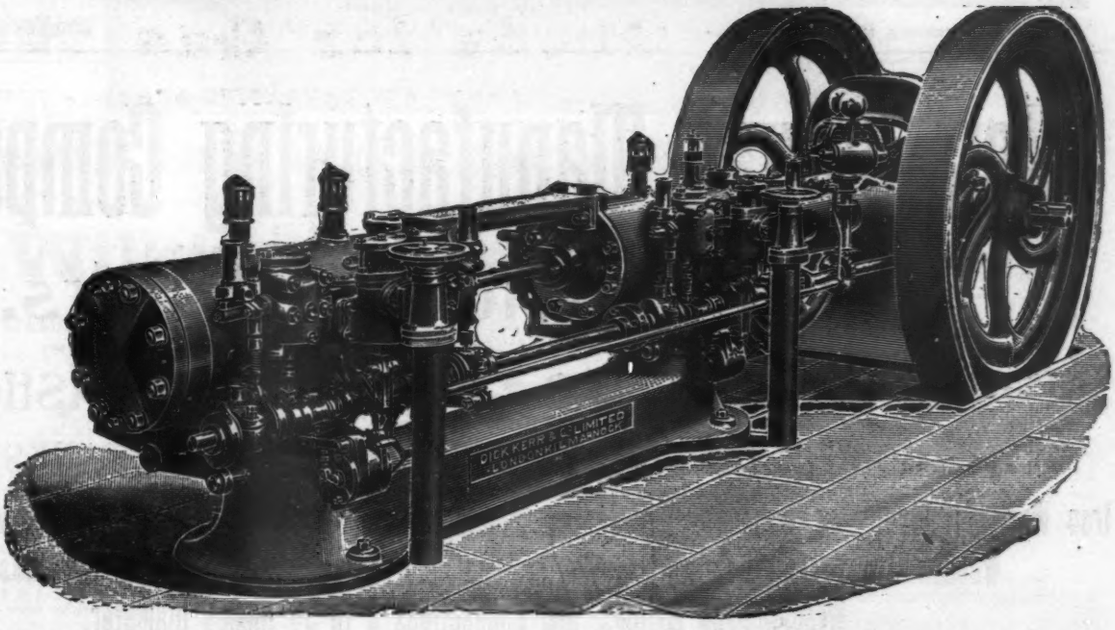

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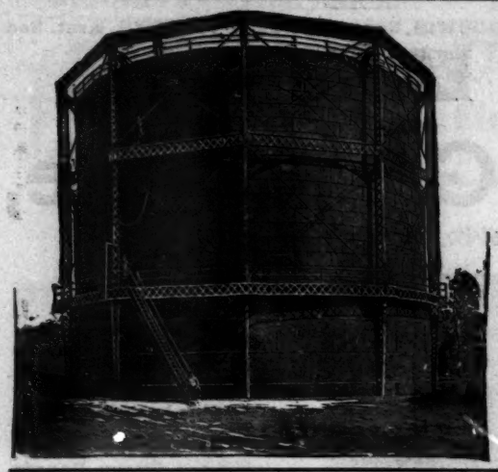

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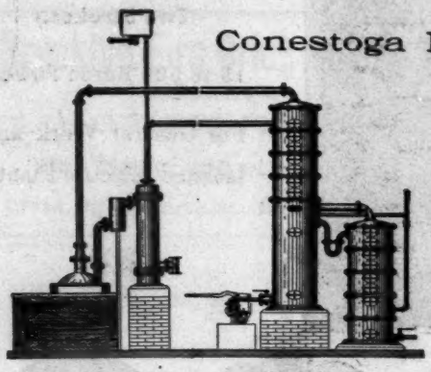

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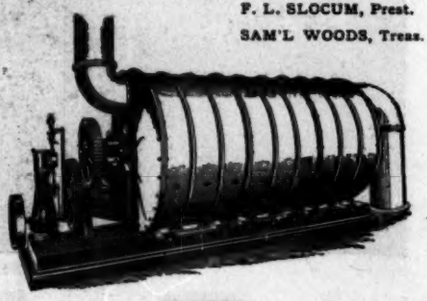

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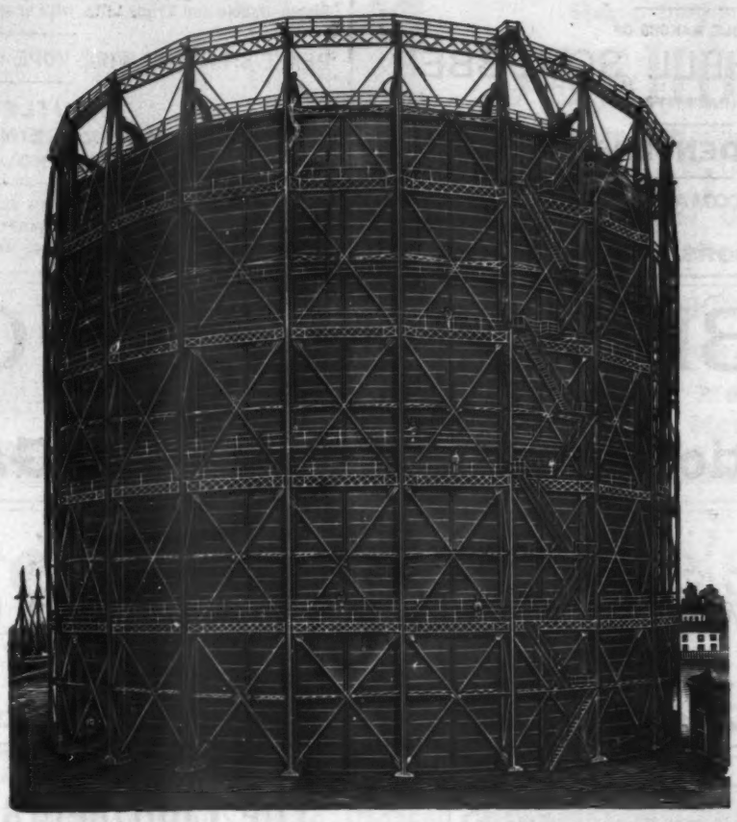

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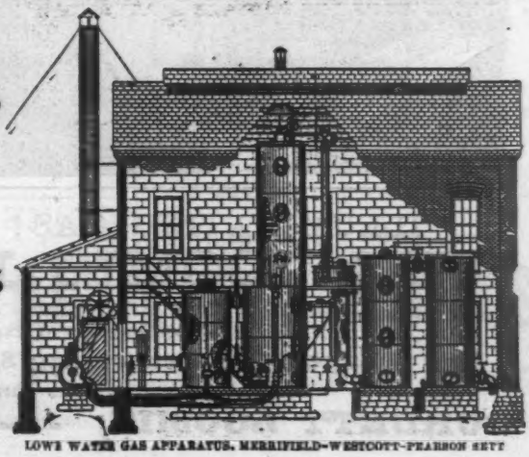

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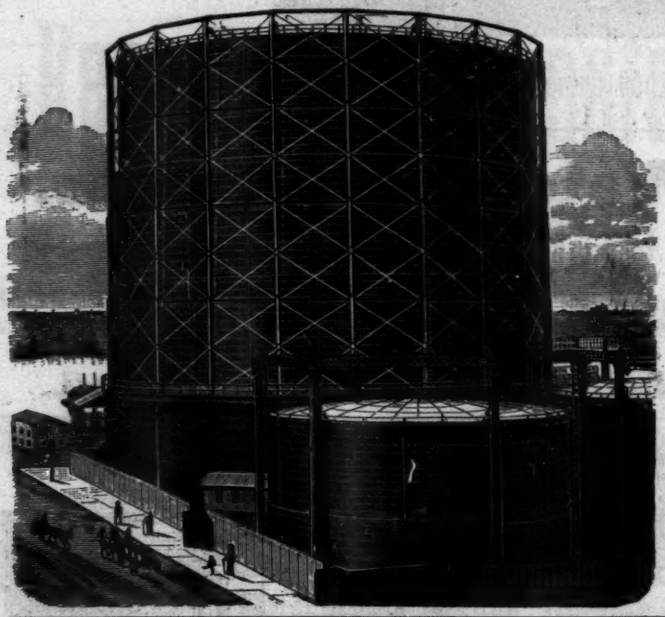

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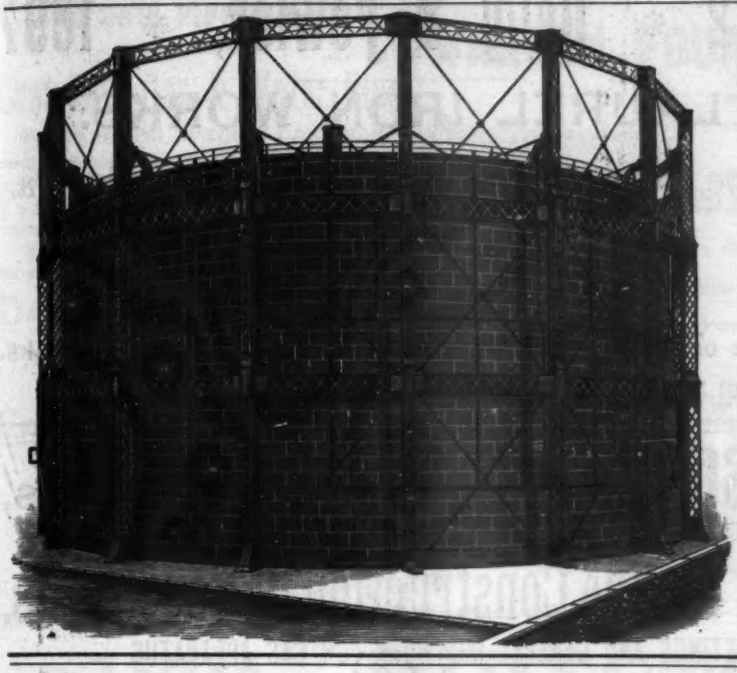

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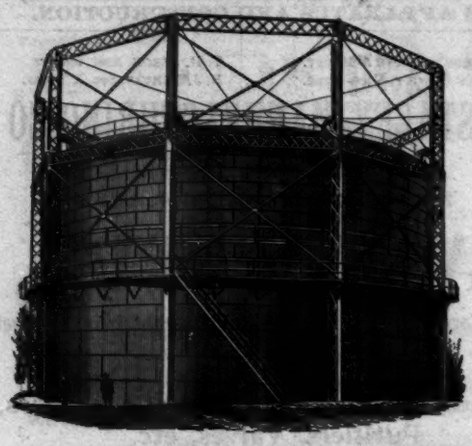

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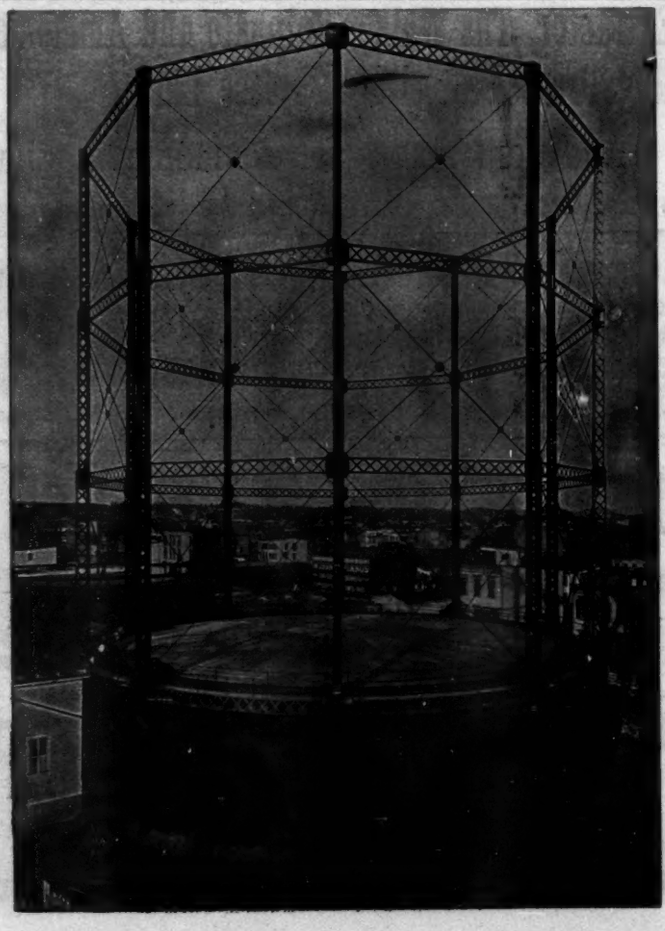

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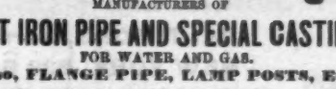

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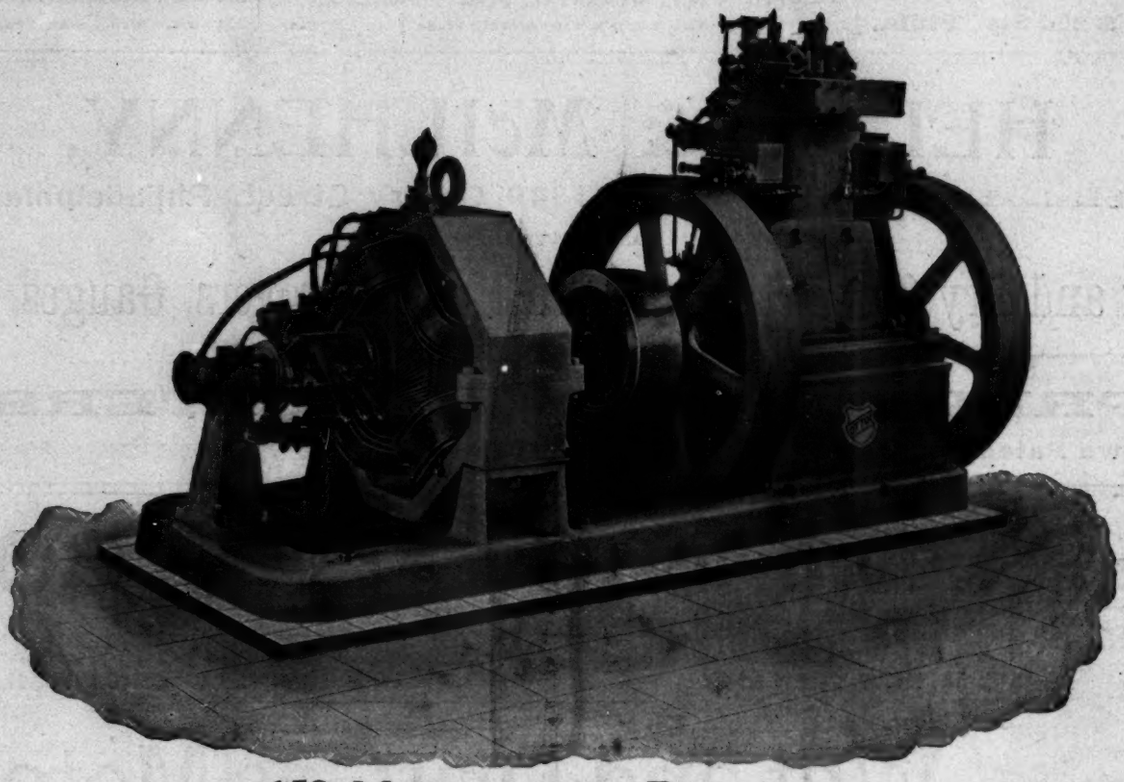

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